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JUNE 2006

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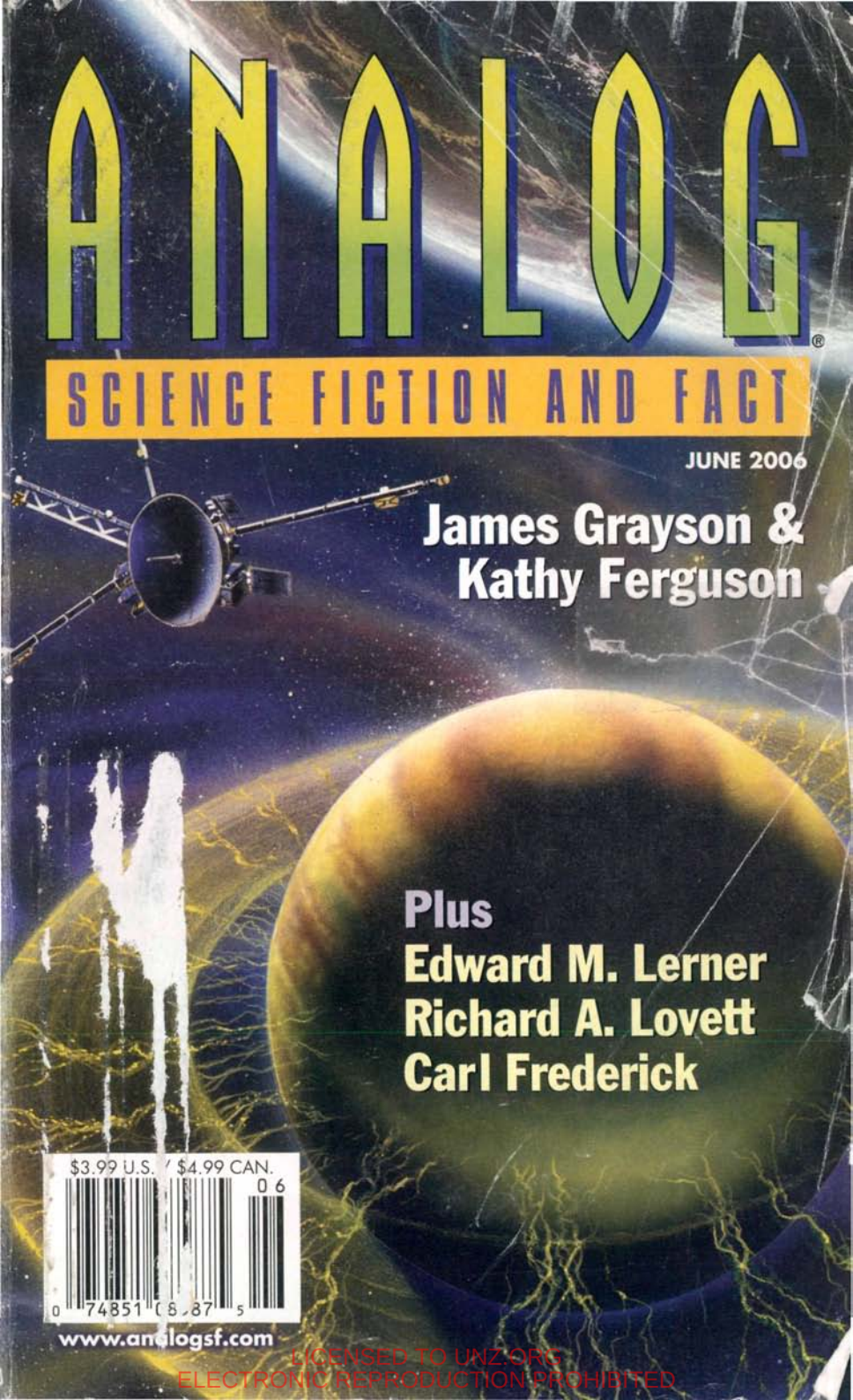

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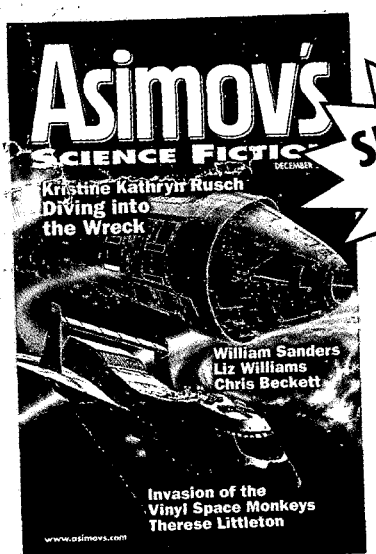

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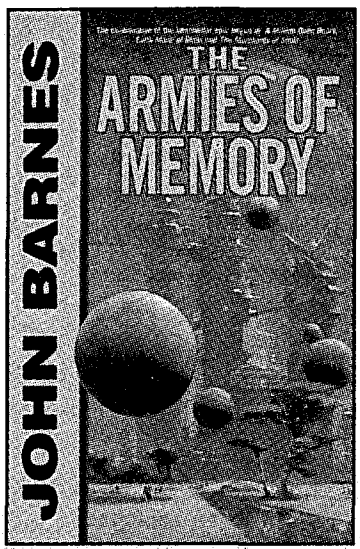

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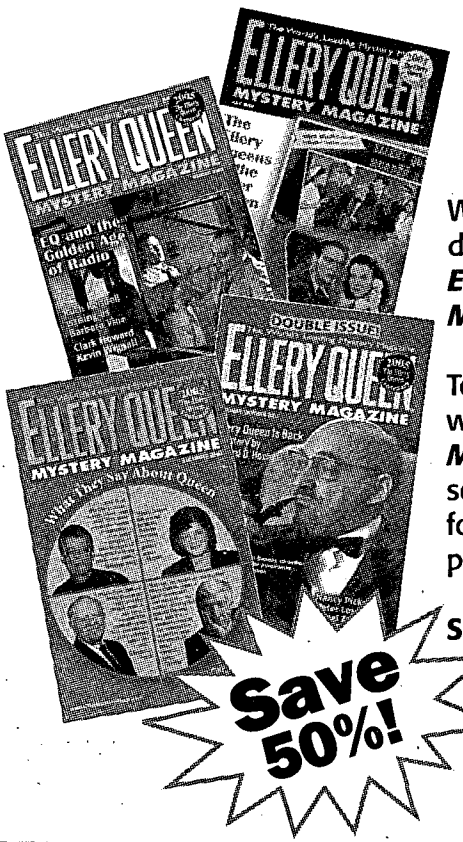

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EDITORIAL Stanley Schmidt

CAN'T ARGUE WITH THAT

In the fall of 2005, the Kansas Board of Education outdid itself. Not only did it (again) welcome creationism into its science classrooms, but it did so in one of the most arrogant imaginable ways: it redefined science, removing the reference to "natural explanations" of phenomena as the central goal of science.

As if the opinion of six members of the Kansas Board of Education will have any effect on what scientists think or do.

Nonetheless, most scientists cringed at this decision, albeit for other reasons, and they weren't all outside Kansas, looking in. There's a tendency in some circles to snicker at Kansas as "backward" when it does things like this, but it's important to remember that the state is not a monolith and not everyone there agrees with the decision. One of the four dissenting members of the board, Janet Waugh, was perceptive enough to say, "This is a sad day. We're becoming a laughingstock of not only the nation, but of the world," a fact you can easily verify by sampling what foreign news media think of these matters. And it was a University of Kansas physicist, Adrian Melott, who said pointedly, "The only reason to take out 'natural explanations' is if you want to open the door to supernatural explanations."

Which, of course, is exactly what proponents of the changed standards want, and most scientists vehemently oppose. It undermines the very foundation of science, which is the idea that what happens in the world follows logically coherent rules and can, at least to a very large extent, be understood by figuring out what those rules are. It has specific methods of trying to do that, and science classes, to be honest, should not attempt to deal with anything beyond what those methods can determine.

But none of that is my main subject today. Even though I obviously have opinions about it, my main goal here is not to debate the rightness or wrongness of the Kansas decision, and I'm certainly not going to rehash well-worn and scientifically unresolvable arguments about whether there is a God or an "intelligent designer." That's a subject on which I (unlike some) freely admit I have no real knowledge and can offer no scientific proof one way or the other. What I do want to talk about is the nature of the "debates" leading up to this decision, and what it says about how debates are conducted—and whether, in some cases, they can't be. This is an exceedingly important issue, and it goes far beyond the question of teaching evolution and/or intelligent design. Whether and how people can have meaningful arguments has direct bearing on their ability—or inability—to resolve *any* question about which emotions run high.

Yes, I've often said that anything is open to question, and to the extent that this magazine has any fundamental tenets, that's one of them. But that does-

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n't mean that all ideas are equally valid (an assertion which the universe emphatically and consistently refutes), or that we welcome with open arms any idea that anyone cares to propound, whether or not they can make a sound case for it. Pretending that every opinion is just another point of view, as valid as any other, is demonstrably false and does no one any service. Some things are simply nonsense and deserve to be called such, without waffling or apology. In principle, it would be nice to always be able to show the holders of such beliefs *why* they are nonsense, without personal animosity but with solid evidence and consistent logic.

Which is why I had very mixed feelings when, during the months before the Kansas board redefined science, hearings to debate the question were boycotted by many organizations of scientists and science teachers. Admittedly nobody has time to craft a careful response to every odd idea that might come down the pike, and as one of the scientists appalled by the Kansas decision, I appreciate the concern of some of the boycotters that the subject of the debate was so utterly foreign to the mainstream of science that their presence might give credence to something that didn't deserve it. As Harry McDonald, president of Kansas Citizens for Science, said, "Public hearings and votes are not how the 'truth' of science is determined. We don't have to lend the credibility of science to the hearings."

But at the same time, I realized that this wasn't just *any* uncomfortable idea, but a biggie: a fundamental attack on science as a part of people's education, being pursued aggressively by people determined to have their way and quite likely to get it. Might the scientists' refusal to participate in the hearings be taken as conceding the point? Some people took it exactly that way, and made political capital of the claim. Brian Sandefur, a board member of an organization called Intelligent Design Network, asked, "Are they afraid to show up? Are they afraid to defend themselves?"

I knew they weren't, but it did occur to me that, in addition to not wanting to dignify the proceedings by acting as if they took them seriously, they might have been inclined to stay away because they figured participating would be a waste of time. I could well imagine that they believed that the hearings were just for show and the outcome predetermined—that it wouldn't matter what logical arguments they gave, because the decision-makers' minds were made up and they would not have listened seriously to anything the "evilutionists" said.

Over the ensuing months, I became increasingly convinced that such a suspicion was well-founded, and increas-

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ingly sympathetic to the boycotting scientists. Quite likely it *would* have been a waste of their time to participate in the "debates." I reached this conclusion partly because of continuing news coverage on the deliberations in Kansas and related ones elsewhere, and partly because of some of the discussion I saw on the "Readers' Forum" section of *Analog*'s own website, growing out of my October editorial on "Cowardice in the Classroom." That editorial was about *de facto* suppression of teaching about evolution even in places where it was officially in the curriculum. The forum discussion started there, but eventually drifted far afield, with a considerable stretch of it occupied by people arguing about the existence of God and possible reasons for accepting or rejecting it.

Some sensible, thought-provoking things were said there, covering a wide range of views, but I also saw a good many examples of some dismaying and unfortunately widespread tendencies. Misrepresenting or twisting what another person said, for example, or jumping to conclusions logically unrelated to the premises, and in general presenting arguments that superficially sound reasonable but aren't, and don't even present a target clearly enough defined to aim logical arrows at. Several times I found myself tempted to respond to something (a temptation I generally try hard to resist, because getting drawn into an argument at one point is likely to make it hard to avoid responding again and again and again). And several times I resisted the temptation, not only for my usual reason, but because the thing I wanted to refute was too inherently illogical to lend itself to a logical response, and context suggested that even if I tried, the effort would be futile.

Let me describe one example, without naming any names, just to illustrate the kind of thing I'm talking about. One forum participant suggested that it would be interesting to compile a list of *Analog* authors who believe in God, but then said that probably wouldn't be a good idea because, in his opinion, I would probably blacklist them. This did require a terse, pointed, and frosty response, because his conjecture was totally groundless and totally false: nothing in my editorial either explicitly or implicitly suggested such a thing, and it's not even remotely true. If I saw any-

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thing to be gained by it, I could easily start his proposed list for him; I can easily name regular *Analog* contributors who represent several branches of Christianity and a couple of Judaism, others who are agnostics, still others atheists, and still others whose religious beliefs or lack thereof I neither know nor care about. His allegation fell short of the legal definition of libel only because it was a false speculation that I *might* do something rather than a false allegation that I *did* do something.

What was interesting, for purposes of this discussion, was his response to my brief note explaining all this. Very politely, in a perfect textbook illustration of disingenuousness, he said that if he had misconstrued anything in my editorial, he would appreciate it if I would point it out. Very briefly, I was tempted to try, but quickly decided there was no point in it. There was no specific thing in the editorial even remotely related to the conclusion he had drawn. I couldn't point to a sentence and say, "This is where you went wrong." He had misconstrued the whole thing, and somehow jumped from the totality of what I said to an offensive conclusion in no way related to *anything* I'd said.

And you can't argue with that—literally. That statement is not an admission that he's right; it's just an observation that the logical disconnect between what I said and what he said is too complete to bridge logically. You can't criticize the logical steps in an argument that doesn't use any.

Moreover, had I tried, I saw no reason to believe that anything I said would have any effect. The gentleman in question, in other parts of the discussion, repeatedly made reference to things I'd said, but in each case he twisted them into things I would never have said. Why should I believe that anything new I might say would fare any better? It seemed clear to me that his opinion was set in stone, and he simply wasn't going to hear anything anyone said that didn't harmonize with it.

Again I stress that my intent here is not to pick on this gentleman, who is certainly welcome to hold whatever beliefs he wishes; or even on the Kansas Board of Education, which is less welcome because it's imposing its beliefs on thousands of schoolchildren. I cite both of them merely as examples of the kinds of difficulties we face in getting people to hold a rational discussion of any emotionally charged issue. Those difficulties are themselves a major problem, because we're surrounded by such issues, and our future will be largely shaped by what kinds of decisions we make about them.

We need to get a lot better at doing that.

One of the skills we all need in order to do so is saying exactly what we mean and listening to exactly what others say. Another is critical, logical thinking. Science courses should be one of the best places for learning both those skills. Six members of the Kansas Board of Education are not enough to prevent that from happening in the nation as a whole, but there is disturbing evidence that they are just one of the more extreme manifestations of a trend. There is also evidence, more encouraging, that that trend is not yet anything like unanimous: voters in Dover, Pennsylvania, soundly voted out a school board that wrote intelligent design into the curriculum there.

Let's hope *that* might set a trend—because if we don't keep the science in science classes, and non-science out, it doesn't bode well for the future of science in this country, and perhaps for the future of the country in general. Stem cell research and other areas that will play a large role in shaping the world's future will not grind to a halt in other countries just because this one turns its back on science. If we do that, we may be left behind in far more ways than we realize. ■

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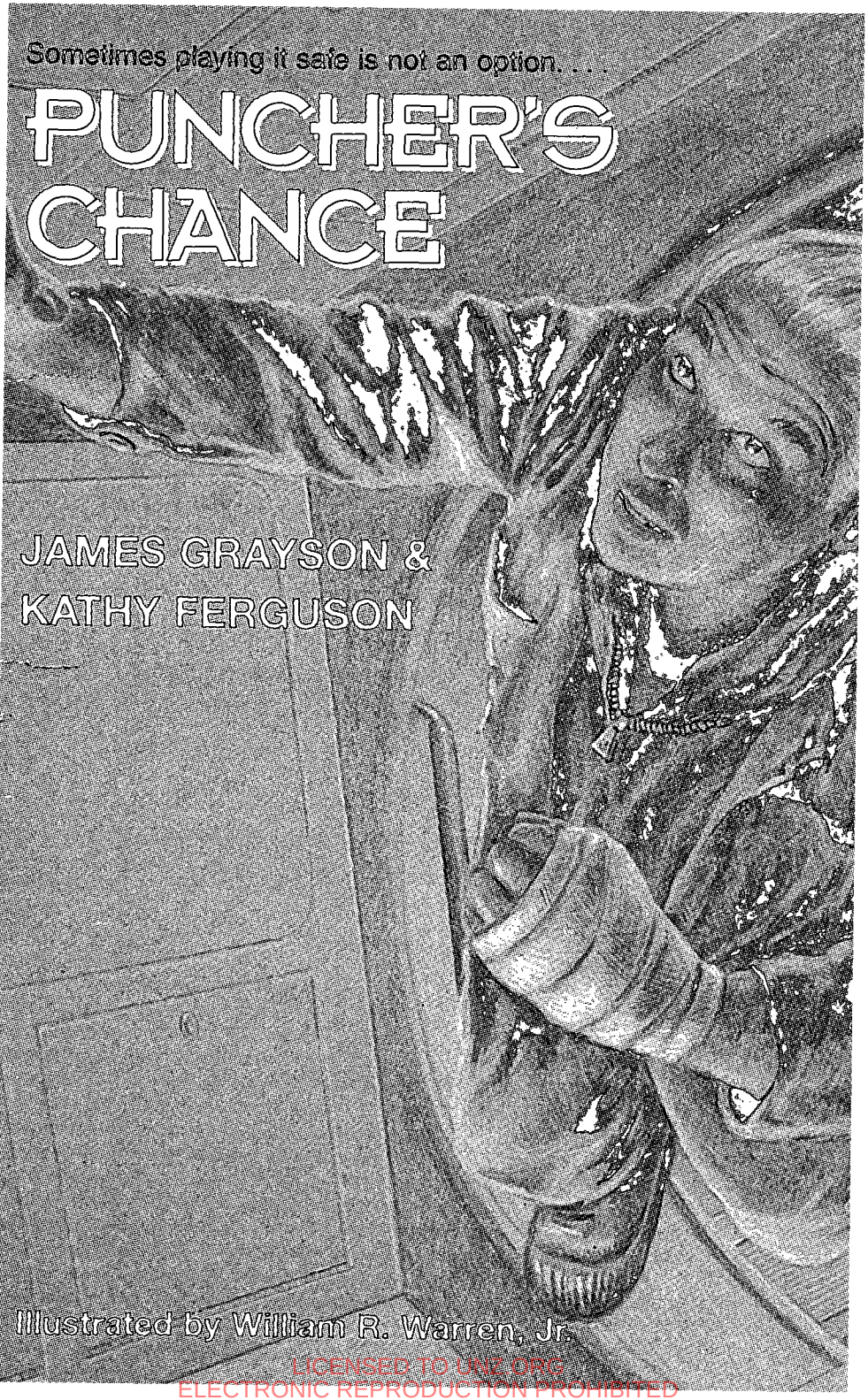
Sometimes playing it safe is not an option. . .

PUNCHER'S CHANCE



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David gazed out the station window, searching for a glint of sunlight off the Low-Earth-Orbit MagBeam platform. It was impossible to spot from this distance, especially against the mottled blue and white backdrop of the Earth, but he searched nonetheless. He made out the shape of North America through murky clouds. Three years before, on a day much like this, his father had perished down there, an infinitesimal speck of humanity buried under a mountain of volcanic ash. He turned to see Gin Fukazawa's face appear on his desk monitor. He grinned at the sight of the Space Transit System's LEO supervisor, twenty years his junior, and shuffled through the piles of tools on his desk for the connection switch.

"Hey, Gin, couldn't wait four more hours to see me?"

"You wish. Looks like three weeks before our paths cross again."

David sighed. "Let me guess. Your boss wants some Martian ice to cool wine at a political function?"

"We all have to please our masters, which is why today you'll be pleasing me by conducting an inspection tour of the High-Earth-Orbit MagBeam platform with a top official from the White House Office of Science and Technology Policy." She wagged a finger at him. "And you'll be on your best behavior."

David groaned. "Another VIP shuffling through? Do I kiss his shoes first, or curtsy? I never remember."

"I'm serious, David."

"So am I. How often do I get real space work these days? I signed up as an engineer, not a desk jockey or nursemaid. At least give me something worth doing while I'm up here."

"Well, I'm very sorry your work's not all fun and games, David, but this is important. This woman wants to tank the appropriation budget for the new colonization shuttles and shut down the Mars colony. Why else the surprise visit? She appeared out of nowhere, stuck her nose into every nook and cranny, requisitioned our manifests and incident reports. She's looking for trouble—and the way she's looking, she'll find it."

Gin's serious brown eyes glowered at him from the monitor. She never looked better than when she scolded him. The prospect of weeks away from her made him frown. Soon enough, her promotion to Mars Colony Coordinator would take her from him permanently. David didn't want to think about spending his retirement on Earth without her.

"You run a tight ship, Gin. I'd sail anywhere with you."

Gin frowned. "If today is any indication, we're all about to drown."

"What's up?"

"The incoming transport is having computer trouble, so we're bumping the *McAuliffe* from the maintenance schedule." Gin raised a hand to stop his protest. "It's not like the old boat doesn't get regular maintenance. You spend half your time on platform tinkering with it."

"Gin, this is the third time! What's the point of having an emergency rescue ship and then letting her rot? Tinkering's one thing, but she needs proper maintenance. Surely the transport can wait a day while the *McAuliffe* gets a thorough overhaul?"

"No can do. I need to turn it around pronto. Your VIP should just squeeze in before all hell breaks loose. There's been a little accident on Mars."

"The control room crew doesn't need me there to run the magbeam. Or for much else, either. What's the matter on Mars, anyway?"

"A check valve malfunctioned, and some hydroponic fungicide siphoned into the water supply. A couple of the colonists bathed in it."

"With what effects?"

"Just irritation and rashes so far, but we're concerned about long-term health consequences if they're left untreated. We're shipping antidote immediately. The sooner they get treatment, the less

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likelihood they'll suffer any permanent damage. If we wait a day now, it'll cost us a week in arrival time."

"Thank you, Gin. I think I remember reading something similar in *Orbital Mechanics for Dummies*. All right, the *McAuliffe* can get her makeover another time. God forbid I should prevent the colonists getting their aspirin."

Gin's shoulders slumped. "Sorry you won't make it to LEO today. I had a bottle of wine cooling." She sighed. "Run along now; your VIP will arrive in about two hours." She cut the connection.

David left his office and tramped along looping metal corridors. Outside, the Earth and stars wheeled dizzyingly as the station's gravity centrifuge revolved slowly. David ignored them. His inspection produced its usual array of irritations, bugs, and blemishes, but nothing dangerous. The whole station needed an overhaul, but with space-hating bureaucrats like Gin's woman from OSTP sniffing everywhere, no one dared put their head above the parapet to request a budget increase, leaving David to waste his few precious days in space on janitor's work. His father would laugh; he'd left the old man's wrecking yard behind for the thrill of space exploration.

He caught sight of a young woman poking inside a wall panel with a voltage probe.

"Ellen! Anything going on I should know about?"

Ellen Francis smiled at her supervisor. Almost impossibly beautiful, but seemingly unaware of it, the redheaded engineer left lovestruck astronauts in her wake wherever she went. David smiled paternally.

"Hi, David. No, just glitches. Nothing worth bothering Maintenance about."

"Glitches?"

Ellen proffered him her portable toolkit. "The flammable gas sensor flatlines over point four percent concentration. It's not really a problem: point four percent's well past the alarm concentration."

David poked around inside a maze of wires. "Had the same problem with these things in F-15 engines in Saudi a thousand years ago," he said. "Turned out to be sand contamination of the pellistor sensors. Chances are something's got in and decatalyzed it." He kept probing around, occasionally holding out a hand for a new tool.

"So how did Timmy Weaver get along last night? It was his title fight, wasn't it?"

David nodded. "Yeah. Wyoming Junior Light-Flyweight Championship. I haven't checked in at the gym, but he ought to have walked it. Kid's got talent like you wouldn't believe."

"Better than you?"

"Way better. Big and strong was plenty in the Air Force championship, but Timmy's got such fast hands, and instincts to go with it. Pride of the gym, he is."

"All thanks to you," Ellen said, with an exaggerated flutter of her eyelashes.

David fixed her with a look. "That's very nearly insubordination, Ellen. No, I like helping those kids. I don't know teaching them to box does much good, but anything must be better than spending all day in an orphanage, right?"

Ellen said nothing. Her thoughts were clear enough, though: *Aren't you an orphan of Yellowstone, too?*

Delicately holding a pasta-spoonful of tangled wires aside, David extracted a tiny ceramic bulb. "Christ on his cross!"

"What?"

"Serial number 223-BR2Z. No wonder it's flaky; these sensors were discontinued in 2011. Ten bucks they cost, but the government still gives us equipment nearly fifteen years out of date."

Ellen yawned and massaged the back of her neck.

"You're on the mission crew for this medicine run to Mars, aren't you?" David said.

She nodded.

"Well, go get some sleep, for God's

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sake. I'll finish the maintenance checks."

"It's all right, really—"

He cut her off. "Don't make me order you, Ellen. It makes me twitch. Go catch some Zs."

She scurried off. David shook his head. More work he'd bought himself. Still, at least it wasn't paperwork, and at least the outgoing shuttle would have someone competent and wakeful on board during acceleration. He pushed the toolkit into his pocket and continued his inspection, wondering how much of his time this VIP would demand.

David tried to mask his exasperation. He'd shown Gin's bureaucrat around the platform and been as polite as possible. In return, she'd spoken barely two words, spending their meeting alternately nodding and snorting at his explanations of how things worked, and taking notes on a handheld computer. Not even the magnificent spacescape from David's office window served to soften her, since she refused to look at anything except her handheld display. After five hours, David could feel a headache building.

Her name was Dr. Victoria Porter. A severe bun of dark hair gave her an older, all-business air, but only the tiniest of lines showed at the corners of her large, dark eyes and pouty mouth, and David guessed she might be in her mid-forties. High cheekbones and an aristocratic nose echoed a tall, willowy figure. With different hair, David could even have thought her attractive—until she'd spoken. Now he only thought her a nuisance. A malignant nuisance. He'd rather have been helping repair the Mars shuttle, not stuck in an office with a bureaucrat firing pedantic questions at him.

"Dr. Porter, occasional minor discrepancies in bookkeeping are unavoidable in any large organization. I can't tell you why July's LEO manifest differs from what was loaded onto the Mars pod, but most likely a breakage occurred and the schedule didn't allow time for a replacement. It's not economically viable to replace non-vital equipment on an emergency basis."

A message alert flashed on David's monitor. Porter made no move to leave, but continued scowling at her handheld screen.

David keyed the message. Gin's face appeared, worry lines creasing her brow. "Gin, good to hear from you. I'm with Dr. Porter. What can I do for you?"

Her expression tightened. "David, the Mars shuttle has an intermittent short in its navigation system. The technicians are swapping out parts to nail down the faulty component."

David whistled. "A sequential fault check could take days. No other indication of the origin?"

Gin shook her head.

David understood her frustration. A few days' delay launching would mean arriving almost two weeks late. "Looks like someone else will have to take the colonists their aspirin. What's your plan?"

"We've no choice. The only other suitable shuttle is twenty days away. We're sending the *McAuliffe*."

"Wait a minute. Six hours ago you bumped the *McAuliffe* from the maintenance roster, and now you want to send her on an emergency mission? What's wrong with this picture?"

"Come on, David, this isn't an emergency, but we can't afford several days' delay. The *McAuliffe*'s in shape, isn't she?"

David snorted. "No thanks to Maintenance. Who's going to fly her?"

"We're transferring the command crew from the Mars shuttle, along with a replacement lander pilot. Karl Masters'll be flying the front chair."

"Masters?" David exclaimed. "Give me a break. Just because he's good in transit shuttles doesn't mean he can fly an old tub like the *McAuliffe*. At least send

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someone qualified."

Gin's brow creased further. "I've contacted Earth. Ben's down with the flu, and Seamus just left on vacation. As soon as they locate him, they'll send him up to take the *McAuliffe* out. I'd like you to get her ready to fly."

"Seamus O'Brien? A man who once quit a vacation on Easter Island because it was too crowded? If he's vacationing within a thousand miles of a launch site, it'll be the first time. Why not let me take the *McAuliffe* over to Mars? I'm the best qualified, and I can have her spaceworthy inside two hours."

"David, is that sensible? How many flight hours have you logged since your last assessment?"

"I designed half the ship, Gin. Do you think I've forgotten how to fly her? Come on, it's a milk run. The planetary alignment couldn't be better, so every minute waiting for Seamus is about three lost at Mars." David glanced up at Dr. Porter, and leaned close to his monitor. "Let me do some real work for once. May be my last chance."

Gin threw up her hands. "All right, you've convinced me. I'll change the crew roster, but you be careful."

"I'm sorry, Gin, okay? But you did say it was important, right?"

She nodded. "Go on, get to work. Here's the Mars incident report. I'll see you on the return run." She gave a weary smile and vanished, replaced onscreen by a document.

David scanned it. "Dr. Porter, I must apologize, but a situation has arisen requiring my attention. We can continue at a later date, or you can address the remainder of your questions to one of my colleagues. If you wish to leave immediately, we can beam your shuttle down to the LEO Platform before accelerating the *McAuliffe*. Otherwise, you'll have a four hour delay before the beam is available again."

She set down her computer. "Mr. Longrie, has the White House been informed of this 'little problem' on Mars?"

"Dr. Porter, my understanding is that someone in the colony has spilled a drink, and they need us to deliver them some paper towels, nothing more."

"I'm sure the director could give me a more detailed explanation. It may have some bearing on my overall evaluation of the program."

David sighed. "There's been a minor chemical leak; just the kind of incident you could encounter in any lab. Some fungicide siphoned into the water supply, and a few people bathed in it. A couple of the scientists have a rash, and the colony medical center doesn't have the medication it needs, so we're shipping some over. It's just a routine supply mission with a tight time-limit, so if you'll excuse me—"

David keyed the number for the shuttle crew station. Ellen Francis' Botticelli countenance appeared on-screen. "Ellen, you've heard the news?"

She smiled. "I've always liked riding in vintage cars. I didn't realize we were getting a vintage driver as well."

"Thanks a lot. You'll be hearing about that one in your APR. Look, we launch in three hours, so can you get over to the *McAuliffe* and start packing her up? The cargo came with the maintenance crew, along with some lander pilot. You can rope him in to help. I've got to go through the preflight checklist, so I'll see you at the loading bay. Okay?"

Ellen nodded. "Sure. I didn't plan on spending this run in a flying toolbox; I'd better be getting time-and-a-half. You must be mad as a snake."

David glanced aside as Porter looked pointedly at her wristwatch. "Yeah, of course. I've gotta go; see you in a few." He cut the connection. He wanted to call the gym to check on Timmy's fight, and he knew he should apologize to Anna for missing the birth of his first grandchild, but he couldn't spare the time.

When David arrived at the docking bay an hour later, his hackles rose. Gin

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hadn't mentioned the name of the lander pilot. Threading between jumbled piles of net bags holding everything from circuit boards to dehydrated fruit juice, and crates of medical supplies, he made his way to the *McAuliffe*'s loading bay doors. Ellen, her arms full of bags, frowned up at another man dressed in a flight suit with US Navy pilot's wings on the collar. A shock of blond hair topped over six feet of muscle and sinew, and a pungent cologne pricked David's nostrils.

Ellen set down her bags. "David Longrie, this is Captain Xavier Beaume—"

"Yes, thanks, Ellen. The captain and I have already met." Neither man extended a hand. David swept an arm around the chaotic bay. "What is this?"

"We're loading the supplies," Beaume replied.

"Loading? It looks like my room in college. Why aren't you using the prepacked pallets?"

"They don't fit on this archaic rust bucket," Beaume said. "Worthless piece of trash should have been scrapped years ago. Which old geezer are they sending up to fly it?"

David's hands curled before he restrained himself. One shot was all it would take, he was sure. Beaume was built like a wrestler, but David would have bet a month's wages he was hiding the glass jaw to end all glass jaws. What had Gin ever seen in him?

"This ship might be old, Captain, but if you treat her with respect, you'll find she's more than capable of doing her job. And if you look, you'll find her cargo bay stacked to the roof with empty pallets made to fit her. I suggest you get a power loader and bring some of them out, because those bags'll shift so much during acceleration we could end up on Jupiter."

Beaume's color rose, but he cut off a retort when Ellen slapped his arm.

"Sorry, David. I should've thought. Come on, Beaume, let's get to it."

As his two crew members trudged off, David passed a despairing eye over the chaotic loading bay. *Why couldn't they have assigned me someone useful?* Beaume, a former test pilot and US Navy Fighter Weapons School trophy winner, seemed to think his star quality extended to areas he knew nothing about. The access door hissed open, and Dr. Porter stalked in, suitcase in hand. The sooner *she* was out of his hair, the better, too.

"Dr. Porter, your shuttle is waiting in Bay 7. You can depart any time."

Her face set hard. "I won't be leaving on *that* shuttle, Mr. Longrie, I'll be leaving on *this* one. I'm coming along as an observer."

"You're *what?*"

"You heard me, Mr. Longrie."

David looked at the sprawling pile of supplies, then at Porter's elegant business suit. "Forgive my asking, but are you space-qualified?"

A genuine smile almost curved her lips. "My office reports directly to the president, and she has *personally* assigned me to this mission."

"The *McAuliffe* isn't a pleasure barge, Dr. Porter. She's not got faux-gravity or mod-cons, and it's sixty days to Mars and back. It isn't like taking the Atlantic tunnel."

"I am aware of that. If you wish to protest, feel free to contact Ms. Fukazawa."

David marched to the nearest communications point.

Gin answered quickly. "I know, David, I know. Instructions just came in from way over my head; there's nothing I can do."

"Does she think the *McAuliffe*'s equipped to haul a passenger to Mars and back? Sixty days with her is not what I need in my life right now."

"Then this should cheer you up—Seamus is at the London spaceport. We can get him back in eight hours. He says he'll fly the mission if you want."

David looked at Porter poking around among the supplies, while Ellen and

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Beaume struggled to repack them. "Do you really want to leave Seamus alone with Porter for two months? If she wants to can the program already, I'm not sure Seamus 'Bungee Jump From An Airplane' O'Brien is the best person to bunk her with. Tell him to enjoy his vacation."

"You're sure?"

David nodded reluctantly.

Gin frowned. "Okay, I'll tell him. Did you call Mike yet?"

"Next on the list. Thanks for keeping quiet about the crew assignment, by the way."

Gin rubbed her eyes. "I'm sorry, David, it slipped my mind. If it makes you feel better, Xavier's a jerk when I see him, too. Just ignore him."

"I'll have to. Or commit the first murder in space."

She didn't smile. "Save the jokes, David. Call Mike, then get back to loading. There's a launch schedule to keep." The screen washed white.

David searched his wallet for the call code of the Orphans of Yellowstone Gym, then waited several minutes before Mike Parry's lived-in face filled the screen, blocking out the punching bags and sparring ring behind him.

"Dave," said the big, black man, "you still in orbit?"

David nodded. "Yeah, something's come up. I've got to fly a rush mission to Mars, so I'm going to be off the map for a couple of months. I'm sorry to spring this on you, but it just fell on me this afternoon."

Parry grimaced. "Well, I can reschedule the other volunteers to fill the training roster, but the kids are gonna be awful sorry. Especially Timmy, after last night."

"I've been up to my ass in alligators ever since I fell out of bed this morning. What happened?"

"Kid just wasn't there. Started badly and never came back—lost his confidence. Got knocked down twice in the first round, and I stopped it in the second. Leaned into a right hand he'd normally slip blindfolded, and got cut under the eye. You know the kiddies' rules when there's blood on the canvas."

"Damn! Timmy should have taken that kid to the cleaners. What did you tell him at the end of the first round?"

"Not to go toe-to-toe with the other kid, keep to the center of the ring and not get caught on the inside."

David shook his head. "Timmy's not a technical fighter; he's heart and instinct."

"What else would I have told him?"

"Go forward, bet it all on one lucky shot. Take the puncher's chance. It's what I would've done."

"He'd have got his head knocked off!"

David shrugged. "Maybe. Or maybe he'd have won. Bet your life he'd have preferred going down swinging, though. How is he?"

"Not too hot. Feels like he let you down. I tried to talk him up, but he went back to the shelter pretty unhappy."

"Christ, I should've been in the corner with him. He's got all the talent in the world, but he needs help focusing. Tell him—" David looked aside as Ellen gave him a piercing whistle from the cargo hatch. "Look, just tell him he didn't let anyone down, and I'll bring him back a Martian rock, okay?"

Parry nodded, and Ellen whistled again.

"Damn. Look, Mike, I've gotta go. I'll see you when I get back."

"Good luck, man."

David killed the connection and jogged across the bay to Ellen. Concerns about the mission crowded out the vague sense he was forgetting something.

The clock counted down toward the end of their acceleration phase. The mission clock ticked quietly alongside it, depressing red figures announcing a twenty-six day wait until their arrival in Mars orbit. David, restless after nearly

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four hours in his seat, checked the voltage and current gauges attesting to the condition of the acceleration magnets on the *McAuliffe*'s underside. They all registered normal, and the propellant and battery levels glowed green. With the ship's attitude controlled by the navigation computer, David felt like a fifth wheel, but he kept his hand hovering near the manual override, just in case.

His earpiece crackled. "HEO to *McAuliffe*, prep for beam shutdown in five minutes, over."

David thumbed the transmit key. "Copy that, HEO. How're we looking?"

"We show you at thirty-eight point four clicks per tick, *McAuliffe*, trajectory five by five. Mars concurs. Range passing two hundred and seventy six thousand kilometers downrange. Right on the money, over."

David touched the data onto the navigation computer screen. "Copy that, HEO. Remind us to duck when the Moon comes along, over."

Laughter rang in his ear. "Will do, *McAuliffe*. Prep for beam shutdown in three minutes twenty. HEO out."

In a little over three minutes, the magbeam—a three-hundred-thousand-kilometer-long bolt of lightning connecting them to the distant HEO station—would shut down, ending their four hours of acceleration. The cloud of argon gas ionized by the magbeam glowed invisibly in their wake, the thrust it imparted on the *McAuliffe*'s acceleration magnets pushing David down into his seat with almost a fifth his normal weight. It would be the last time he felt weight for a long while. The Earth's heartbreakingly beautiful blue and white disk receded in the viewer; Mars still lay invisibly distant somewhere ahead and to the right.

Beaume grimaced in the copilot's seat, his muscular frame too bulky for the cramped cockpit. He was wearing cologne, and David wondered which of the women it was meant to impress. Even Beaume must have realized Porter was way out of his league, and David smiled as he wondered how long he would take to discover that the preternaturally beautiful Ellen was also gay. He'd warned a few optimistic, young astronauts off her in the past, but looked forward to Beaume finding out the hard way.

David would have preferred to see Ellen in the cockpit, but Beaume needed to get acquainted with the controls. Interplanetary flight protocols just weren't part of the training for lander pilots, however talented. Besides, Ellen was still orienting their unwanted "observer" to the vagaries of life on the *McAuliffe*. So far, Dr. Porter hadn't left the lav for more than fifteen minutes at a stretch, and they weren't even at zero gee yet. If she didn't stop heaving soon, he'd order her drugged up until she adjusted. He was tempted to order it anyway, just to keep her out of his way. He ran a hand through his close-cropped grey hair and tried to relax the muscles in his neck and shoulders. His head throbbed.

"Past your bedtime, gramps?" Beaume said.

David shot him a savage look. "Do you intend to do *any* work on this flight, or are you just gonna park your ass in front of the vidscreen all day like you do on those landers?"

Beaume grinned and stretched expansively, his shoulders muscles rippling.

David ducked aside. "And put your damn restraint belt on. I don't need you bouncing around the cockpit when they turn the beam off."

"Ooh, sorry," Beaume said, not moving. "This is *so* much more dangerous than flying an F-18. Just imagine what could happen if I got a jolt at a whole point-two gees. It could crush my eyeballs to jelly and snap my spine."

No, asshole, but I *could.* "Just put the damn belt on, or it goes in your performance report as a safety violation."

The radio burst into life. "HEO to *McAuliffe*, come in, over."

David touched his earpiece. "We read

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you, HEO, over."

"HEO to *McAuliffe*, prep for beam shutdown in one minute, over."

"Copy that, HEO. Initiating shutdown procedure, over." David thumbed the 1-MC control to transmit across the whole ship. "Longrie to all crew. Brace for transfer to zero gee in forty-five seconds." He slotted his headset into its receiver.

The overhead speaker crackled. "HEO to *McAuliffe*. Shutdown proceeding in ten, nine, eight—"

David took hold of the jolt bar above the instrument panel and looked levelly at Beaume. He held out until six, then reached for his restraint belt and slotted it deftly home over his chest. On zero, a slight jolt forward signaled the shutdown of the *McAuliffe*'s thrust. David flicked controls to deactivate the acceleration magnets and propellant feed, set the batteries to begin recharging from the solar panels, then unbuckled his restraint belt.

"Gin said something about you being too cautious," Beaume said. "Maybe that's why she asked me onto the crew: girl needs a bit of excitement in her life again."

David stopped, one hand clenched white into the back of his seat: Restraining himself, he reached for the communications panel. "Longrie to all crew. Magbeam shutdown complete and propulsion secured. Out."

David shot along the narrow aisle toward the galley area, anger making him push off harder than he intended. He wanted an aspirin and a bulb of coffee. By now he should have been lying next to Gin in her quarters on the LEO platform. Maybe Beaume was right. Maybe he was an old geezer flying an outdated bucket of bolts on a pointless, cover-your-ass mission. Thirty years as an astronautical engineer, and here he was, reduced to flying suitcases of itch ointment to Mars with Gin's jerk of an ex-boyfriend. He could have been mopping the decks on the platform for all the good he was doing.

He swung into what served as the *McAuliffe*'s kitchen and common area, hooked a foot into a toehold, and popped the lid on the first-aid kit. A series of racks held an assortment of medicines in single-use packets, all filled to the top—except the aspirin rack, conspicuously empty. Cursing, he slammed the lid closed.

"That didn't sound good." Behind him, Ellen guided Porter into the cramped space. The two women glided to the table, and Ellen propelled Porter into a seat. The Assistant Director of Space and Aeronautics at the White House Office of Science and Technology Policy looked green.

David rolled his head around to loosen the tension in his neck. "Aspirin supply got left behind. Shipful of emergency medication, and I can't get a damned aspirin."

"Just hook your foot under the bar down there." With her charge anchored at the table, Ellen glided smoothly from the room. She returned a minute later and handed David two aspirin. "I always carry my own, just in case."

David smiled wryly. "Remind me to give you a raise when we get back. Do me a favor and go make sure Beaume doesn't accidentally fire off the thrusters or jettison our water supply, will you?"

Ellen gave him a grin and a mock salute. "Yes, sir! And did you remember to tell Anna you'd miss the big day?"

David released a string of profanity. He'd promised his daughter he wouldn't let space prevent him from attending the most important moment in her life this time. So much for promises.

Ellen arched an eyebrow at him. "I'll enter that in the logbook as a 'No.'"

As she floated away toward the cockpit, David rummaged in a supply cabinet for a bulb of coffee. Sleep would have been better than caffeine, but Beaume's taunt rang like a bell in his head, precluding any chance of rest. He glanced at Porter.

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The good doctor hunkered over the table, her knuckles white. The dark, rich chocolate of her hair accentuated the paleness of her skin. Not even her peach lip-gloss could mask a bloodless face. She stared vacantly at the wall, her pupils bare pinpricks.

"Can I get you some coffee, doctor?"

She shook her head without looking up. David tossed his bulb into the galley's microwave, twisted the dial, and muttered in frustration when nothing happened. He was damned if he was going to spend twenty-six days on unheated STS reconstituted food, so he snatched up a screwdriver.

Porter finally moved her eyes, watching him as he probed around the back of the microwave. "If Beaume isn't qualified, should you be letting him fly the ship?"

David left the screwdriver hanging in midair and glided across the galley. "I'm not. We're on an inertial trajectory; just coasting. We can't even change our course without a magbeam powering us. Nothing much to do now but monitor communications and life support and watch the batteries recharge."

He returned with a handful of tools. After a few moments poking inside the microwave, he replaced the back, reconnected the power, and smiled as it burst into life. "I take it you haven't spent much time in zero gee?"

"It doesn't take a space jockey to decide whether a system is running safely and efficiently, or whether it represents the best use of taxpayers' money. And I do have a postgraduate degree in physics."

The microwave pinged, and David extracted his coffee. "If the politicians were worried about safety and efficiency, we wouldn't be sitting in a geriatric ship headed out to Mars at twelve hours' notice. We'd have a modern, properly maintained shuttle with a dedicated crew on permanent standby for emergencies."

She took her eyes off the wall and met his, avoiding the galley's tiny porthole. "Another fancy toy needing tens of millions of dollars to maintain, just so a handful of 'special' people can play at being pioneers."

"The Mars colony is run for the benefit of everyone, not just the people in the space program."

"What nonsense. What would you say if there were a catastrophic event like the '21 Yellowstone eruption, and the government was too busy indulging your pipe-dreams to build safe shelters on Earth? 'Sorry you died, folks, but we just *had* to see whether there was life on Mars?'"

What would I say? How about 'Sorry I abandoned you, Dad?' Maybe space wasn't *worth it.* David threw the aspirin down his throat with a swallow of STS coffee substitute. "My shift's over. If you're too sick to go to the exercise suite today, you can skip it, but you'll need to be in there by tomorrow at the latest. I'm going to get some sleep."

David swore as the edge of the circuit board sliced his index finger. He scrounged a rag from his back pocket and applied pressure to the cut. The first-aid kit probably wouldn't have any bandages. Like every ship, the *McAuliffe* boasted a thousand different subsystems. Half of them he'd upgraded himself during his years of tinkering, but the rest were as reliable as politicians in election year. He'd spent almost every waking hour in the fortnight since launch fixing niggles and glitches.

Ellen glided up and offered him a beverage bulb. "How goes the repair?"

He took a swig and gave her a black look. "What the hell is this?"

"Sorry, boss, it's the only caffeine we have left. It's tea with cream, just the way you like your coffee."

"I take my coffee with cream and *sugar*."

"Not on this boat. And you'll be taking it black tomorrow."

David sighed. No coffee, no cream,

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no sugar, but enough chicken soup to feed an army. Heaven only knew what else had been left behind between Beaume's junk sale and the scramble to make room for the exalted Dr. Porter. At least she had the good grace to stay out of his way. He spotted Beaume swimming along the corridor toward them. *If only we could have left* him *behind instead of the coffee.* His shoulders tensed as the pilot drew closer. He wasn't sure he could make it another eleven days without slugging the guy. Once Beaume realized David's authority over him didn't extend beyond the end of the mission, he'd gone from being merely insubordinate to openly offensive.

"Ship still falling apart faster than you can put it back together, Longrie?" Beaume didn't quite stop in time to avoid bumping against Ellen.

She slid away. "Anything else I can get for you, boss?" she offered. "Need any parts from stores?"

"There aren't enough parts in the whole system to fix what's wrong with this piece of junk," Beaume said. "Gin's crazy thinking it'll get us to Mars. I sure ain't taking it coming back."

David glowered at the pilot. "You want to jump ship early, the airlock's just behind you. Anyway, aren't you supposed to be on watch in the cockpit?"

"Sure, but I came to tell you Gin's on the horn."

"You could have used the intercom."

Beaume raised his eyebrows in mock surprise. "You mean it's working again?"

Ellen gave him a disgusted look. "Give it a rest, you idiot. You broke it in the first place, trying to wire in your stupid music system."

David gave the petite engineer a glance, wondering if Beaume had finally made his inevitable pass at her.

The pilot snorted. "Don't talk dumb. I've done it a thousand times before, and it's never caused trouble."

David pushed himself upright. "This isn't one of your new commercial landers. You can't jump into the wiring without checking the layout first. This ship needs care and experience, not some cowboy fumbling around where he's not qualified to go."

Beaume stiffened. "Hey, who the—"

David cut him off. "Just keep your damn fingers out of systems you don't understand, all right? I've got enough to do without cleaning up your messes."

He finished tidying up the circuitry and pulled himself in the direction of the cockpit. Beaume eased a shoulder against the companionway wall, putting himself in David's path. With no handhold to grab, David cannoned into him and spun away from the pilot's greater bulk, rolling over and bouncing painfully into the wall. Beaume laughed.

David's patience snapped. He checked his spin with an outstretched hand, braced his foot against the wall, and thrust himself towards Beaume, right fist first. With two hundred pounds and an amateur heavyweight's technique behind it, the uppercut sank in under Beaume's ribs and doubled him up. David took a wild left hook easily on his guard, and responded with a sharp double jab to the bridge of the nose. Beaume's head went back, setting him up beautifully for the crunching right cross that followed the jab as night followed day.

It didn't land. Ellen seized his arm on the backswing and, her foot anchored under a trip bar, pulled him around to face her. "Enough, both of you! David, stop acting like a kid and go get Gin's message!"

Beaume recovered his balance, coughing. "Yeah, get into your stairlift and go see what your night-nurse wants."

David tried to lunge for him, but Ellen kept him pinned back. "Shut your face before it gets damaged, Beaume," she snapped. "I'm sick of the pair of you."

David pushed off for the cockpit. A knot of wiring lay draped across the cockpit deck, vanishing into the back of a homemade stereo box. David yanked

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the wires unceremoniously loose, booted the stereo into the companionway, and set about reconnecting the intercom. The few minutes' work gave him time to compose himself before he played the message from Earth. Gin looked years older. Dark half-circles discolored the skin under her eyes, her mouth was pinched, and her hair hung slack and dull.

"Bad news, David. We have new cases appearing by the hour, and much more serious than before. Apparently some of the contaminated water was used to brew coffee. When it's ingested, it migrates slowly to the nervous system and eventually the liver and kidneys, where it has devastating effects. Two of the early cases are comatose, and the infirmary's medical supplies are running low. They can keep people stable, but they need the antidote to flush the toxin out of the tissues. We're sending more antidote on another shuttle, but she won't arrive until two months after you. Once you dock at the Mars orbital platform, get your supplies to the surface as quickly as possible, to tide them over until the relief shuttle arrives. You'll need Xavier to fly the station lander down. Both colony pilots are grounded."

Surprised as much by Gin's appearance as her news, David took a moment before sending a reply. "Message received, Gin. Don't worry—we'll get the supplies there for everyone who needs them."

David swiveled up from the pilot's chair and came face to face with Dr. Porter, drifting silently in the cockpit doorway.

"Still think it's just a milk run?" she asked.

David tossed his soup bulb into the galley disposal and drifted toward the door. It was his turn on the exercise wheel, and he welcomed the diversion. After twenty-five days, they were all on a short fuse. Porter remained sullen and uncommunicative, Beaume obnoxious and cruising for another fight, and even Ellen's determinedly cheerful humming grated on David's nerves.

"David?" Ellen's voice crackled over the intercom.

"Yes?" he barked. *What's broken now?*

"You have an incoming message."

He pushed off and cruised forward to the cockpit. Ellen started to unbuckle from the pilot's seat, but David waved her down. She snatched her handheld as it drifted away. He could make out enough of the screen to recognize a graphic novel. *What happened to the days when people read real books written with real sentences and paragraphs, requiring the reader bring some imagination? Now it's all picture books with captions.*

David switched on Gin's recorded message. If anything, she looked worse than a few days earlier, when she'd reported three more colonists slipping into critical condition—bringing the total sick to thirty—and informing him the infirmary's medical supplies were almost exhausted. But this time a wan smile played across her lips. "Congratulations, David! You're a grandfather! Jodie Melissa Smith was born at 1:42 this morning, weighing eight pounds three ounces. Mother and baby are both doing great. I sent a balloon bouquet in your name. Take care. I miss you."

Ellen whooped and punched his arm. "Congrats, old man! This calls for a celebration! And I know just how to do it. Follow me."

She led him back toward the galley, pounding on Beaume's door as she passed and disappearing inside the cabin where she bunked with Dr. Porter. She emerged a moment later with two Hershey's chocolate bars and Dr. Porter. Beaume, rubbing sleep from his eyes, drifted sullenly behind them.

They all crowded into the tiny galley, where Ellen announced the happy event. She passed out bulbs of juice, and proposed a toast.

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"To Jodie on her birthday. May she have a long and happy life, and follow in her grandfather's footsteps." Grinning, she rapped her bulb against David's and the others followed suit. Even Beaume managed to raise him a convincing smile. After taking a sip, Ellen unwrapped the chocolate and distributed halves around the group.

"Chocolate," breathed Porter, popping a piece in her mouth. She closed her eyes and a moan issued from her lips. David tucked his own morsel of chocolate into his pocket and watched in amusement while Porter savored the treat. Finally swallowing, she opened her eyes to see them all gaping at her. Flame red shot up her face.

Ellen coughed. "Well, I'd better get back to the cockpit. Still my watch."

"Don't forget the battery level check's due this shift," David said. "Earth'll want to know how much we've got in the tank."

Ellen nodded and drifted out of the galley.

Beaume followed hot on her heels. "Hey, I'm claiming the reader."

Their voices faded as they bickered their way through the length of the ship. David shook his head. Good thing they were only twenty-four hours from the Mars platform, or they might have their space murder yet.

Porter cleared her throat. "If they're any indication, we won't arrive a moment too soon. Now that I've made this trip, I can't understand why anyone would put up with it."

David finished his juice. "It isn't all like this. Sure, the travel can be a bit uncomfortable, but I warned you the *McAuliffe*'s not a pleasure barge. The vista on Mars will be worth it, though. It's like nothing you've ever seen before."

"The cost for us to admire that vista is astronomical. How can you defend that when so much remains to be done on Earth?"

David sighed. "It's not just about admiring the vista on an alien world. Earth's a dangerous place: war, famine, disease, global warming, asteroid strike, supervolcanoes like Yellowstone. We're just tenants on planet Earth, and the landlord could evict us any time he likes. The rent's been rising for decades, and it's time we took the hint."

Porter raised an eyebrow. "Is there a point to this poetic aside?"

David tossed his juice bulb into the disposal. "Like you said, the '21 eruption was a wake-up call. Self-sustaining colonies would ensure the human race could survive another plague like AIDS or the '09 flu pandemic, or the second coming of the Yellowstone supervolcano when it happens."

"And how many lives will be saved in your colonies? A few hundred? What about the billions on Earth who'd be better prepared for a disaster if we spent the resources there?"

"I don't buy that. Our budget wouldn't save billions of people on Earth. Magbeam's cut costs enormously. Sure, the colonies aren't ready yet, but if we put the effort in, we avoid having all our eggs in one basket if the worst happens. That's worth a little risk and discomfort."

Porter laughed. "Maybe you space cowboys want to risk your necks out here, but ordinary people don't give a damn whether we have colonies on Mars."

David waved his hand at the walls around them. "This ship's official name is just some six-figure project code, but years ago I rechristened her with a tiny red ribbon and a champagne miniature. She's named for a school teacher of mine, Christa McAuliffe. She wasn't an astronaut or an adventurer, just an ordinary teacher with a husband and two children, and an understanding of how space could open doors for a kid like me. She inspired me to quit my dad's wrecking yard and go to college, and later to leave a dead-end career in the Air Force and go into space. She was one of

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the seven people who died when the *Challenger* space shuttle exploded. She never saw space, so I brought her name with me. Ordinary people do care."

Porter opened her mouth and closed it again. For the first time, David saw her hostility melt, saw a soft, vulnerable woman emerge, felt his own pulse quicken.

Ellen's leaden voice spoke over the intercom. "David, we have another transmission from Earth. One of the Martian colonists has died."

David's heart sank, and Porter turned sharply away.

"We don't belong out here."

David came convulsively awake, adrenaline bursting through him as the raucous blaring of the Master Alarm shattered the silence. The lights flickered, and the rotating amber of the alarm indicators turned the cabin into a chaos of shadow and light. David wrenched at his sleeping belt and lunged for the door. The ship lurched, and his head hammered into the bulkhead. Ears ringing, he hauled himself into the corridor. The ship stopped shaking, but the lights continued to wax and wane at half their usual intensity. As he dragged himself toward the cockpit, the other cabin burst open to reveal a half-dressed and disheveled Dr. Porter, naked terror in her eyes. David ignored her, pulling himself forward hand over hand. He wrenched the door open to find the cockpit empty, its darkness punctuated by a flickering aurora of emergency warning lights, flashing urgently in myriad colors.

"What's happening?" Porter screamed. Her eyes were wide and white, and her hands shook.

"Christ knows!" David yelled back. "Some kind of power failure. Any sign of Ellen or Beaume?"

She displayed enough self-control to shake her head, at least.

David wormed his way into the cockpit and plucked up an emergency headset. Its power lights remained dark. "Damn it! Communications are down. Follow me!" He shouldered Porter aside and thrust himself along the main companionway toward the engineering spaces. At the first connecting hatch, he looked back. Porter clung to the cockpit door, transfixed by the play of warning lights across the control panels.

"Porter! Move your ass, damn it!" he shouted.

Shocked out of her inaction, she followed, fumbling clumsily along in his wake.

As David thumped to a halt against the engineering hatch, a fire claxon burst out, fast and insistent, louder even than the Master Alarm. He seized a fire mask from the wall and pulled it over his head, then grabbed an extinguisher and opened the hatch.

Banks of hulking battery cells stood in rows, electrical relays and monitoring equipment sandwiched alongside. At the far end of the compartment, from between two batteries, fire poured out into the central walkway. Unconstrained by gravity, it dipped and whirled, spreading and splashing outward like a liquid, bright oranges fading to blue. And over the banshee screeching of the alarms a more primal sound issued: the scream of a human being in agony and terror.

David thrust himself forward, arrowing along the central walkway with the extinguisher held out. A quick burst of carbon dioxide dashed away the drifting droplets of flame, and he thudded home against the side of one of the batteries. He sucked in a deep breath and pushed off for the center of the fire, spraying the extinguisher indiscriminately before him. He hammered into something solid, and felt choking heat below him. A globule of liquid fire splashed onto his hand, and he roared in pain.

Another extinguisher opened up, bathing him in white clouds of CO_2, and the heat subsided. David spotted Porter anchored a few yards from him, extin-

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guisher in hand and a mask over her face.

Over the blaring of the alarms, he shouted to be heard. "Porter! The fire's out! Just inside the hatch there's an emergency venting control—a red handle. I can't see a damn thing in here."

She nodded and dragged herself away. David pulled himself down to the deck. Billowing clouds of gas masked everything, forcing him to search by touch, not knowing what he might find. The screaming had stopped. A sudden howl announced the activation of the emergency venting fans—*thank God they've got a stand-alone power supply*—and the clouds whirled away up to the extraction port in the ceiling. After a few moments, the room cleared enough for him to see again.

"Porter! Get over here! We've got people down!"

David stared down at the bundle of sheeting held fast in a cargo net. Through the plastic, he could no longer see the charred flesh that used to be her rosy cheeks, the scorched and blackened teeth that had once been her vivacious smile, but they were in his mind nonetheless. He'd suffered ten minutes of dry retching before he'd been able to bag her up, telling himself the tears were caused by pain from the convulsions in his empty stomach. Ellen Francis had died on his watch—*his watch*. As the commander of the vessel and leader of the crew, the responsibility was inescapably his.

But Ellen had been more than just a colleague. She'd been friend, comrade, and confidant. She'd been the woman he wished his daughter could become, from whom she could hardly have been more different. Anna shunned him, blaming him for the divorce; Ellen always wrapped him in warmth. Bold, courageous, always smiling, she'd thrived in space. When the panel turned down her application to join the Martian colony permanently, she'd just lifted her chin and soldiered on, taking the rejection a thousand times better than he did.

David secured the cargo net and wiped his eyes. There was work to be done. He floated into the engineering space where Ellen had died, levered away an electrical panel, and lost himself in a labyrinth of burnt wires and molten fuses.

Porter touched him on the shoulder, and he turned to face her. "How's Beaume?"

She shook her head. "Not good. He's alive, but barely. He has a burn on his right hand where the electricity entered, and another on his right instep where it went to ground. If the current had crossed his heart, he'd have died immediately. I administered drugs for shock and started IV fluids. What happened?"

David gestured to the monitoring panel in front of him, illuminated by a spacesuit's spotlight. Rows of charge gauges registered zero. Even the warning lights below them were dark. "The ship's entire electrical reserve shorted through them. Shouldn't have been possible, but the safety interlocks isolating the batteries from one another weren't activated. I guess it was Beaume who forgot; the interlocks are automated on the modern shuttles he's used to."

"The charge must have gone through both of them," Porter said. "Beaume was lucky and Ellen wasn't. I hope she died before the fire reached her."

David's jaw tightened. *She didn't. I heard her screaming.* "These gauges are shot: I don't even know how much power's left in the system. There's been charge backstreaming throughout the ship: systems are shorted or fused everywhere I look. I've cut us down to minimum life support to conserve what we have."

"We can recharge the batteries from the solar panels, can't we?"

David squeezed his eyes shut. "There's a nominal seventy-two hour

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recharge time. I've already started the process, but we're not getting much power through, and we've only got sixteen hours until beam pickup."

"What's the bottom line?"

"It takes about seventy-five percent of the total battery capacity to run the magnets for a full four-hour deceleration. The best I can figure, they're at about five percent capacity. They've been recharging throughout the trip, using the excess energy from the solar panels, but we lost nearly everything in the accident. Even with life support at minimum, the panels are so damaged they're only providing a trickle. Even if we turned life support off and took to suits, the batteries couldn't gather enough power by the time we reached the beam pickup point. There just isn't time."

Realization dawned. "Oh no—"

David met her eyes. "We won't have enough power to decelerate. I'm sorry."

She slumped back, blinking away tears.

"Porter—Victoria, listen. We're not helpless. We've still got supplies, and the panels are providing enough power to run minimum life support pretty much indefinitely. They'll send someone out after us."

"A rescue at nearly forty kilometers a second?" A look of hope died, stillborn. "I'm not a complete fool, David. We're not going to make it."

"Don't think that way. They brought Apollo 13 back safely. We're not—" He stopped.

Porter blinked at him, then voiced his unspoken thought. "Free return trajectory?"

David nodded, amazed the thought hadn't occurred to him before. *Ellen's dead, damn it. Get your mind back to the problem.* "It could work, too. I'd need to know exactly how much we have in the batteries, and somehow get a transmission to the Mars station. But if there's enough juice left, we could run the magnets to slingshot us around Mars and back towards Earth. That's only a short interaction: we've gotta be able to get enough power together for it. By the time we get close to Earth, the batteries should have recharged enough to decelerate at HEO station. If we can get the orbit right." He snatched up a scratch pad and grease pencil and started jotting figures. "Ever done orbital calculations before?"

Porter shook her head. "I can do the mental arithmetic if you want, though. I won a state prize for it once."

David grinned and thrust the pad toward her. "All right, then. Check those numbers. Us engineers can't do big math without taking our boots off first." He grabbed the access cover for the battery control panel and scrawled on its surface.

Porter, more animated than he could remember seeing her, jotted rows of tiny figures along the borders of the pad, brushing her hair absently back from her eyes and muttering silently. David looked at her and thought of Gin, whose same intensity had won her the posting to the Mars colony. He slowed his own scribblings, then reached out and touched Porter's shoulder.

"Porter, stop. It's no good."

"No, I think it'd work! We'd only need a velocity change of one or two kilometers per second, and the trajectory's—"

He held up a hand. "I mean, what about the people on Mars? We're supposed to be thinking about them, not us. Without our medical supplies, most of them will die. We're on a rescue mission; we can't just run away."

Porter stiffened. "Wait a minute, Longrie! You can't just throw away a chance to save us because you think your heroics will somehow resurrect the colonization program. You're beating a dead horse. The president won't back the appropriations bill for colonist transports. In another year, Mars will be abandoned."

"Maybe. But it's still there now. And nearly a hundred people could die with-

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out our help."

"Well, that's tragic," Porter said, "but it was their own mistake that put them in danger. We're on a crippled ship with hardly any power. We'll be lucky to save ourselves, let alone a bunch of colonists. It's simple common sense. If the lifeboat springs a leak, you don't send it out in a storm. Let the relief shuttle rescue the colonists."

"The relief isn't due for two months. Without our supplies, the colonists will die long before it arrives. And what about Beaume? Do you think he'd survive a two-month trip to Earth? Are you ready to watch him die?"

"What the hell does it matter whether I want to save him? You said it yourself: there's no power to decelerate. What do you want to do—crash into the planet at forty kilometers a second and hope the medical supplies survive?"

"What if I could think of something—build something—to extract power from the magbeam?" David mused. "It's essentially electricity, after all. After we pick up the beam, we could recharge the batteries before switching the magnets on."

Porter chewed her lip. "But then you wouldn't have four hours' deceleration time. We'd overshoot."

David grabbed his grease pencil and scribbled furiously. "Not if we decelerated harder than normal. The platforms are tested at something like a hundred and twenty percent of normal operating levels."

"And if it isn't enough?"

"I didn't say it would be easy. But we won't have to strip off as much velocity as normal. We're not looking to rendezvous with the magbeam platform: without Beaume there's no one qualified to pilot their lander."

"So how the hell do we get to the surface—sprout wings and fly?"

"Back in the Stone Age, before magbeam, the *McAuliffe* was the first ship ever to make a successful landing and relaunch from Mars. The magbeam harness is just strapped on; it's got explosive bolts so it can be jettisoned for maintenance. If we cut it loose after we decelerate, she'll be reentry-capable again. Reentry orbit is faster than the beam platform's orbital velocity, so the deceleration should be a bit easier—"

"As easy as free return?"

"No, but if we can tell the Mars station to switch to a high-power beam after we've recharged our batteries, we can push ourselves into a reentry orbit. Then we use Mars' atmosphere to aerobrake and glide in."

"You're insane, Longrie. For God's sake, listen to yourself. You've got a granddaughter now; don't you want to see her? Because if you try this crazy plan, you never will."

"You'd rather run away?"

"Are you calling me a coward?"

"What would your superiors think if you took the safe route and let the colonists die? I'd have no choice but to report you vetoed an alternative."

Her brows drew down. "So now you're threatening me?"

"I'm just asking you to think about the effect this could have on your career. Think of all the headlines if we save all those people. Isn't that worth taking a chance for?"

"In other words, 'sign onto my lunatic scheme, or I'll ruin your career?' Nice try, but I think my bosses are a bit more objective than that. Why are you so dead set on trying to be a hero?"

"Do you know anything about boxing?"

She shook her head. "What are you getting at?"

"When a boxer's outclassed, he's got two choices. He can either ride out the punishment, accepting the defeat but not getting hurt, or he can forget about defending, go forward, and try for the knockout, even though he could get badly hurt trying. We call that taking the puncher's chance. When I was twenty-two, I won the Air Force Heavyweight Championship that way, against an op-

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ponent ten times as good. Got my nose broken, but I won."

"So?"

"This mission is right on the ropes, and way behind on points. We could take the shots on our guard, but however well we duck and weave, we still lose. If we take the puncher's chance, we can win clean: save ourselves, the colonists, everything. But we've got to risk walking into the big punch for it. We can't let those colonists die without taking a few swings for them first. What do you say?"

Porter chewed her lip, and David thought he saw a moment of doubt cross her face. Then her mouth curled. "Goddamn space cowboy!" She pushed off awkwardly for the engineering compartment door and banged hard against it on her way out.

David tried to pin the circuit board to the work surface with his wrist. It was no good. The board slipped, and David cursed as he soldered two channels together. The globule of burning plastic had left the back of his hand so blistered and throbbing he could hardly use it. He tossed the board aside into a growing cloud of botched components hovering next to a sheaf of scribbled notes, then looked up at the mission clock on the galley wall. With heartless precision, it announced beam pickup in thirteen hours, forty-one minutes, and eleven seconds.

Porter had vanished into the cabin they were using as a makeshift infirmary, refusing to speak. She pulled herself through the galley occasionally to retrieve more medical supplies for Beaume—her color fading from furious red toward pallid white with each circuit—but each time she ignored him. *Trying to wait me out. She knows my solution will take longer than hers.* But for all the lives hanging on it, David would have laughed at their petulance. *I may be going to die out here, but they'll not say I ran away.*

The galley door opened, and Porter floundered silently in, awkwardly upright as always. She said nothing, avoided his gaze, and dragged herself toward the medical kit. David, focusing more on her than his work, scraped his hand against the edge of the table.

Porter turned and frowned at him while he clutched his wrist and cursed. She pulled herself closer and scrutinized his hand.

"Bloody fool. Why didn't you say something?" She rummaged in the first-aid box for burn ointment and bandages. By the time she finished wrapping the hand, the ointment was starting to relieve some of the throbbing pain.

"Thanks." He flexed the hand, frowning at how the bandage limited its usefulness.

She scowled and turned to leave.

"That's the first time you've spoken in more than a hundred and fifty thousand kilometers," David said. "A bit less than an hour ago, we came within two million kilometers of beam pickup. I'm trying to modify the emergency transponder to send out voice messages: the shipboard communication system's fried. If we can't send messages to the Mars station, we won't even be able to navigate a free return trajectory. At least let's do *something*."

Her scowl softened a fraction. "What's wrong?"

David held up his hand. "Damned burn. I feel like I'm trying to sign my name with my boxing gloves on. Is Beaume stable?"

She nodded reluctantly. "The medical monitor will alert us if his condition changes. What can I do?"

David gestured to the cloud of discarded circuit boards with its magic carpet of sketches and mathematical speculation. "Grab one of those and hold it steady for me. This should be a ten-minute job, but soldering's a cast-iron bitch in zero gee. Doesn't flow properly." He worked as he spoke, hoping she'd ask

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the vital question.

She did. "What's the drawing?"

He shrugged. "Idea of mine. Not sure about some of the science, to be honest; I'm more of a nuts and bolts man."

Porter raised her chin, but held out the circuit board and said nothing.

"Just turn it over for a second. Thanks. Okay, you can let go now." David gathered up half a dozen circuit boards and began slotting them into the transponder. Porter eyed the bundle of filmies. *Come on. Let's see the ambitious, nosy bitch who made my life hell back in orbit.*

While David fitted pins and wires to the transponder, Porter brushed one of the spoiled circuit boards to one side, then reached out and pulled the bundle toward her. David concentrated on the intricate wiring. Plastic rustled as Porter turned to the second page, and she hummed faintly.

A few minutes later—six minutes and thirty-one seconds according to the mission clock, or about fifteen thousand kilometers—David risked an open glance at Porter. She still floated next to him, clutching the tabletop with one hand. Her eyes riveted on the sheets, she nearly bumped her shoulders into his chest. David coughed.

She looked up in surprise, the last of the pages in her hand. Startled by their proximity, she drew back. "This won't work, you know. The incoming ion velocity's too high."

"I was thinking of using a collider to slow them down," David said. "Something like a tapering metal funnel, to slow them by collision until they're ready to deionize."

Porter shook her head. "It'd need to be huge. What you want is something like a giant multichannel plate."

"A what?"

"Electron multiplier. Basically an array of slanted tubes bundled together and coated inside with a scintillating compound. Electrons collide with the inside wall and set off a charge cascade. We could use the same thing—without the compound, of course—to slow the incoming ions before they separate."

David nodded. "I see. The electrons and ions rattle around like peanuts in a jar, then come out the far end slow enough to be used. By using narrower tubes, you make the collisions take place in a smaller space, right?"

She gave a sudden smile. "Exactly. They'd need to be the right length, though, or the beam would deionize before you got any current out of it."

"How long?"

"Depends on the angle of slant. I could work out a formula."

David grinned. "Brilliant. I can get all the tubing we need out of the plumbing system. So, once we've got the magbeam slowed down to a manageable level, what then?"

"Well, once you've slowed the beam, you can use an electric field to separate it into electrons and ions, like you suggest, and you should get a current between your two collectors. What were you going to make them out of?"

"I thought something like the mesh screens out of the ventilation system. The separator I could make out of some metal blinds from a fan outlet—"

"With the louvers alternately charged positive and negative," Porter broke in. "I see. You'll need several layers of mesh for the collectors if you want to keep the efficiency up."

David nodded. "I know. My main concern is heat dissipation. A full-power magbeam would fry anything we could build. If the incoming power's too high, it won't self-cool quickly enough. We need to get the Mars station to run at low power while we're recharging, then turn the power back up past a hundred percent when we're ready to decelerate."

"Well, contacting Mars is no problem if your transponder works."

David chewed his lip. "We'll only be able to send, not receive. Our long-distance receiver is slag, and the ones in

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the spacesuits aren't compatible. We won't know whether Mars received our message."

"How long do you think the converter would need to recharge the batteries enough to decelerate?"

"I was hoping you could help me with the numbers. I did a couple of estimates, but you're the math wiz."

Porter shuffled through the sheets, flailed helplessly in midair for a moment until David dragged her to a seat, then set to scratching figures. Every now and then she would snap her fingers and demand some esoteric figure of merit for the ship or magbeam: mass, battery capacity, charge ratios, power consumptions, ion velocities. Without resorting to computer or calculator she jotted for ten minutes, then triumphantly double-underlined a number.

"Forty-seven minutes, thirty-one seconds!" she announced. "That's a minimum, of course."

David closed his eyes and silently blessed the bloody-mindedness of physicists in the face of an intriguing problem. "Okay. If we call it an hour for safety's sake, we'll still have three hours' deceleration at a bit under a hundred and thirty three percent power. We've got thirteen hours to build this thing and get it into place. I'll need to go EVA to secure it. That's a two-hour job in itself, so let's get to work."

David took a deep breath and started the recorder attached to his improvised transmitter.

"Mars station, this is the *McAuliffe*. At present this is the only communications channel available to us. We do not—repeat, do not—possess the ability to receive communications on any frequency. We have suffered a massive power failure and lack sufficient battery reserves to undergo a standard deceleration. Two crew are down. Life support at minimal levels. State of navigation system unknown. We intend to use a space-mounted electrical converter to recharge our batteries from the magbeam prior to executing an emergency deceleration to Mars entry orbit—repeat, Mars entry orbit—for landing and direct rendezvous with the colony for immediate cargo delivery.

"Execute standard beam pickup, but operate magbeam at one-zero percent power output for six-zero minutes after acquisition. Then increase magbeam power output to one hundred and twenty-nine—that's one-two-nine—percent standard and maintain target lock for one hundred and eighty minutes. We'll do the rest. Wish us luck, Mars station."

He set the recording to repeat and dragged himself from the cockpit.

The build had taken far longer than David anticipated, but finally the converter was complete. It didn't look like much for ten hours' work. About the size of an armchair, the bulk of it was comprised of the big metal blinds from two ventilation ducts. Each of the pivoting metal leaves was attached to the terminals of a tiny power supply cannibalized from a spacesuit. To either side, two metal cylinders jutted. Inside them, behind David's hasty welding, lay the two ion collectors, built of dozens of layers of fine metal mesh. Great coils of insulated power cable protruded from each collector, to carry the electricity they hoped it would generate. He'd spent three hours making the ion collider, welding four hundred lengths of metal tubing to the front of the assembly in an array like a narrow slice cut from a bundle of drinking straws. Heat sinks and cooling fins bristled here and there, welded on wherever space permitted.

David stood back, trembling from pain and fatigue. He couldn't count the number of times he'd jarred his burned hand in the past hours, turning the persistent burning into lances of fire. The ointment did little to stop the pain, and edema puckered the inflamed skin, swelling his hand to half again its normal size. Porter hung next to him, dirty

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and exhausted but with a curious glow about her, like a child with a new finger-painting to show her parents. Between them they pushed their creation towards the airlock.

David pulled a stretchy, one-piece spacesuit undergarment from the rack, then stripped down. He glanced up to see Porter averting her eyes, red creeping up to her face. He pulled on the skintight pants and tried to insert his burned and bandaged hand into the sleeve. After barely an inch, he stopped, weeping in agony as the tight material tore at his burnt hand, setting it bleeding.

"Longrie? Are you all right?"

He gasped, trying to recover his breath. "Hold the sleeve straight for me. I'll try again."

She did, but the tight suit still crushed the bandage against the burn. He stopped her, breathing hard. "It's no good. Even if I can get it on, I won't be able to use the thruster controls or tools properly. You'll have to do the EVA instead."

All color drained from Porter's face.

Porter clutched the edge of the galley table, her knuckles white. The mission clock ticked away behind her, unnoticed. After four weeks in space, he should have guessed. All the signs were there: she never admired the view from a porthole, always aligned herself with the gravitational axis of the furniture in the ship, always moved between handholds without drifting free.

David sucked his teeth. "Why the hell did you insist on coming?"

"What was I supposed to do? Tell my boss, 'Sorry, I can't go on the inspection tour because I'm afraid of falling. Your Assistant Director of Space and Aeronautics is terrified of space?' I'd have been the laughing stock of Washington. Besides, my psychologist told me I could be desensitized if I exposed myself to space. Damn crackpot. Let him take a walk off the edge of the Grand Canyon, see how he likes it."

"You fell from the edge of the Grand Canyon?"

She nodded, empty-eyed. "I was nine. My father took us on vacation there. My brothers wanted to use the binoculars and stargaze. We sneaked out of the tourist area after dark and walked along the edge for a while. We were looking up, pointing out the constellations. I stepped over the rim.

"I hit a ledge about twenty-five feet down, broke my arm, and fractured two vertebrae. I lost the use of my legs and only managed to stay on by clutching some weed growing out of the rock face. The rescue squad took two hours to reach me. All I could see were the stars above me and the darkness below, waiting to swallow me whole." She shivered. "Now you see why I can't go out in a spacesuit?"

David spoke quietly. "Even if we turn off life support this minute, the solar panels won't be able to gather enough power for a free return trajectory. If we don't get the converter into place, we die. It's that simple."

Porter turned haunted eyes on him. "I'm sorry."

Three hours and twenty-one minutes until beam pickup, the mission clock warned. David cast about helplessly. *Take the puncher's chance.*

"Your therapist thought you could get over this by being exposed to what you fear most, did he? Let's try it. We'll start slow, maybe just looking out a porthole. I'll be there to talk you through every moment of it, from start to finish."

Porter gaped at him. "You're crazy!"

He barked a short laugh. "Do you have a better idea?"

David locked Porter's helmet into place. She stared out through the plastic shield, her dark eyes wide with frightened anticipation. He touched a control and was momentarily blinded when the four spotlights mounted around the helmet blazed to life. He gave her a thumbs-

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up and squeezed out through the airlock's inner door, then swung it home and spun the locking handle. Over the past half hour he'd coaxed her into the clumsy carbon-fiber suit, pushed her to gaze out a porthole while floating free, and now had her ready to open the outer airlock—he hoped. She'd cursed him a blue streak throughout.

He pulled the communications cap from another spacesuit over his head. "Porter, give me a radio check."

"I can hear you."

"Great. I'm going to pump the air out. You don't need to do anything." He pressed the Atmosphere Purge control and heard the whirr of the extraction pumps. She didn't know he was running internal life support at a dangerously low level just to hoard enough power to run them. He hoped a handheld atmospheric sensor would warn him if the air became too stale to breathe.

"Okay, Porter, we're ready to go EVA now. Do you remember what I told you?" He wished he could see through her visor-mounted camera, but with the ship's systems down, crackly suit-to-suit radios provided their only link. All he could do was wait by the cargo bay airlock and talk her through the operation.

Her voice wavered. "Yes. I'm pulling the external release handle now."

The residual atmosphere in the airlock whistled away out of the hatch. Porter's breathing accelerated as she looked out into the vacuum of space.

"You're doing great," David assured her. "Clip the converter to your belt." He looked through the airlock porthole and saw her latch the bulky instrument onto her spacesuit's retaining harness, next to the connection for her safety line. "Okay. Are you ready to go outside?"

Porter drew what sounded like a steadying breath. "Why the hell did I let you talk me into this?"

"Because I'm your Prince Charming. Use the grab handles along the walls to pull yourself towards the hatch. Take it slowly and don't forget you need to stop the converter as well as yourself when you get there."

"All right, I'm at the hatch. I can see outside." After a pause, she went on, quavering. "My God, it's full of stars."

David grinned. "Sure it is, Commander Bowman. To the right of the hatch is your first handhold. Grab it with your right hand, then bring your left hand across your body and reach for the next handhold beyond."

He glanced down at his watch. In just under two hours and forty-five minutes, the magbeam would reach out to them. If the converter wasn't there to meet it, he and Porter would die more alone than two humans had ever been. He looked up. Porter hadn't moved. The converter drifted to the end of its short tether, tugged at her frozen figure, and began its slow return trip to her side.

"Porter, reach for the handhold."

Her raspy breathing filled his earpiece.

"Take the handhold in your right hand and swing across to the next one with your left. Victoria! Do you hear me?"

An alarm buzzed, barely audible over her panicky breathing. If it were a warning from her suit, he would have heard it more clearly. Abruptly, it stopped. Frowning, he glanced around the cargo bay.

A squeal came through the earpiece. "Ow! Damn contraption! Who the hell built this heap of junk?"

David peered into the now empty airlock. "What happened?"

"Your little fixit toy nearly sliced my suit open with its damn pointy corners. How the hell am I supposed to drag this thing all the way out to the magbeam ring?" A long string of profanity followed.

"Try shortening the tether." He could hear her ragged breathing and continuing mutters. "How far have you gotten?"

"Not far enough. This is impossible. I think I'm going to be sick."

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Not with the meds I pumped into you, you're not. "Just take slow, deep breaths. Let yourself hang in space for a minute. Focus on relaxing. You'll make faster progress if you're relaxed."

The faint buzz of the alarm reached him again. He pulled off the communications cap, using both ears to pinpoint the sound. To the left, he decided, somewhere up near the engineering section. He drifted to the hatch. As he reached it, the buzzing stopped. Placing the cap back on his head, he heard Porter setting off a new string of curses.

"Calm down, Victoria, and tell me what's wrong."

"The damn tether is caught on something! I'm still five meters from the magnet harness, and I can't go any farther."

David returned to the airlock, and inspected the windlass through the porthole. Plenty of line remained on the spool, but the line trailing out the door stood taut. "Victoria, can you see the full length of your line?"

"Yes, of course I can see it. There's nothing else out here. It must be snagged inside the airlock."

David groaned. Just what they needed—a jammed windlass. Fifteen minutes for her to return to the airlock, ten minutes to repressurize, then twenty-five more to pump the lock out again and return to the magbeam harness. Fifty minutes wasted, plus however long it took him to fix the windlass. Too long. He took a deep breath.

"Victoria, your tether's stuck. You'll have to cast yourself loose."

The shriek in the earpiece nearly deafened him. "What? Do you think I'm a lunatic? I'm not about to cast off my safety line!"

"We're out of time and out of options. Either you unclip the tether, or we die a hundred million kilometers beyond the asteroid belt." The alarm buzzed indistinctly, barely audible over Porter's protestations. David pushed off for the engineering section. Maybe the life support systems were tripping an atmospheric sensor. His handheld sensor hovered between green and yellow.

"Look, Victoria, the suit has thrusters built in. If you lose your grip on the handholds, you can use them to push you back to the ship, just like I explained to you. You're safer than walking down the street in D.C. Get yourself back to the handholds, unclip your tether, and pull yourself on to the magnet."

More curses, then, "All right, I'll do it."

David grinned. "Atagirl. You'll be fine, I promise."

The radio crackled in his ear. "Longrie, what's that noise?"

The alarm stopped, and David looked around intently, trying to imagine what it could have been. He shook his head. "Nothing important. Just my radio. Banged it and got some feedback going."

"Well, don't do it again. I nearly jumped out of my skin." Porter's voice eased, and a few minutes of silence passed. "I'm at the magnet now. How much time do we have?"

David looked at his watch. "You're doing fine. Just make sure you get the converter securely attached as quickly as you can."

He continued trekking through the engineering spaces, checking subsystems and sensors. Nothing registered an alarm. Porter's scream stiffened every muscle in his body. "Victoria, are you all right? What happened? Victoria?"

"Damn! The converter is drifting away! I just let it go for a second to get a tool out. I can't reach it!"

He stifled a curse. "How far away is it?"

"Two meters. I can't reach it from the handholds. It's getting farther away all the time."

David took a breath. "Victoria, let go of the handhold and use your suit thrusters to reach the converter before it goes any farther."

"I can't."

He heard her sob, pictured tears

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welling in her eyes. That she'd gotten this far was nearly miraculous, but if she let the converter get away, it would all be for nothing. "You can, Victoria. You can do this. It'll be just like when you were on the tether. Use the thrusters to go to the converter, clip it onto your belt again, then head back to the ship."

Sheer terror swelled her voice. "No, I can't. What if the suit thrusters run out of gas? I'll be stuck out here, falling forever."

David thought about how he'd handled young boxers afraid to fight on after a knockdown. His watch showed less than two hours to go, and the job of bolting the converter in place wasn't even begun. They were in the final round and needed to deliver the knockout blow, but the clock was ticking down towards the bell—a bell that would signal their deaths, as well as those of Beaume and God knew how many colonists.

"You're not falling, Victoria. You're swimming—swimming between the stars. There's no place to fall to, no planets to suck you down to their surface. Think about swimming, Victoria. You're not afraid of falling when you swim, are you?"

She sniffed, and then answered in a small voice. "No, I don't fall when I'm in the water."

"And you aren't falling now; you're floating. Use the thrusters to help you swim to the converter. Think of it as a life buoy. Swim to the life buoy and bring it back to the ship. Do it now, Victoria, before the life buoy is too far away."

She sniffed again and hiccupped. He thought he detected the sound of teeth grinding. After several minutes of heavy breathing, she reported she'd retrieved the converter. David gave a silent prayer of thanks. "Well done, Victoria. Now go back to the magnets and secure it. We don't have much time."

"We've done it, David. We've done it! The converter's in place!"

Porter beamed as David helped her out of the airlock. Fatigue lined her face, and her hands shook as she removed the outer shell of the spacesuit, but her eyes were wide and her voice slurred as if she was high on drugs. David admitted to himself that the clinging undergarment looked a lot better on her than it did on him, as did the crazy grin they shared. No sooner was she free of the spacesuit than she threw her arms around him, the strength of her embrace pleasantly surprising, her lips close to his. To look at her, she could have been through a war, but new confidence gleamed in her eyes. He hugged her tightly, and she squeezed his shoulder, feeling the muscle, looking at him with lips slightly parted.

"You did great, Porter. I'm proud of you."

She kissed his cheek. "Vicky," she whispered. "My friends call me Vicky."

"Vicky." He tried the name for size, and found it fitted her. "Well, Vicky, I think you've done enough to deserve a little prize."

She looked up at him from under long eyelashes. "And just what did you have in mind?" Her fingers touched his earlobe, stroking gently.

David felt his face redden, and fumbled in his pocket. He pulled out the lump of chocolate handed out by Ellen at their abortive celebration, and proffered it to Porter with an apologetic smile. "I tried to get something better, but the confectioners don't deliver this far."

The fragment was gone from his hand before he saw her move, and suddenly he was pressed back against the wall with her legs braced against him and her fist twisted in the front of his shirt. "You've been hiding this from me all this time?" she demanded, her face savage. "All this time?"

David recoiled from her fury, then jerked in surprise as she burst out laughing.

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"Fooled you!" She broke the bar into two pieces and held a fragment up to his mouth with delicate fingers. With a pang of guilt about how it would have looked to Gin, he let her feed him the piece of cheap chocolate. Ecstasy overtook her face as she consumed the other, and she pressed herself against him harder, then licked her fingers lasciviously clean, one by one, right in front of his face.

She gave a rapturous smile. "Not bad, but shouldn't you have ordered Mars bars?"

He kissed her. There didn't seem to be any other response. He meant it to be momentary, but her arms locked around his neck and held him until they were both out of breath. They only parted when his watch let out a beep. She looked at him in gentle query.

"Five minutes until beam pickup," he explained, regretfully. "It's game time. You remembered to switch on the power supply to the separators, didn't you?"

She flicked his ear. "I'm not incompetent, David."

He smiled. "No, Vicky, you're not." He pushed off for the engineering section, trying hard to forget the taste of chocolate on her lips.

Porter trailed along behind him, and bounced to a halt as he stopped at a voltmeter attached to one of the battery panels. "When will we know if this converter of yours worked?"

"If we don't explode in the first seconds, we'll know when this little gizmo bleeps at us."

"Explode! You never said anything about an explosion!" She grabbed his shoulder and spun him around.

There was no point in deceiving her any longer. "If Mars didn't get our message, and picks us up with a full power beam, the batteries'll get a high voltage spike before the converter melts. It could trigger an explosion. I don't know about you, but I'd rather go quickly than starve to death in the outer reaches. Nothing I could do about it, so I didn't think you needed to know."

She swelled up in anger, then just as abruptly deflated. "Thanks, but I'd rather have known."

David shrugged, and took her proffered hand. "One minute." They clung to each other, staring at the voltmeter, lying blank and silent as the time ticked down.

"Thirty seconds," David said. "Fifteen. Ten. Five. Time."

Silence. No explosion, no sound from the voltmeter.

"Time plus five. Time plus ten. Plus twenty." He looked down at the frightened woman clutching him. "I'm sorry, Vicky. I'm truly—" The ventilation fans sputtered, then sped up, pushing cool cabin air over them both. David opened his mouth just as the voltmeter sounded. Its electronic bleep could have been a siren's song for the effect it had on them. Porter whooped like a cheerleader, and David threw back his head, roaring in triumph.

"That one's for you, Christa!" he shouted, then turned to kiss Porter again, who grinned like a fool. "It's working, Vicky," he said. "We just scored our first knockdown. Let's make sure the bastard doesn't stand back up again."

"Yes! Now we're motoring!"

Porter stumbled into the cockpit, no longer submerged in Stygian gloom, but filled with bright lights and video displays. Above the viewscreen, the mission clock announced the beam pickup was fifty-three minutes old, while another ticked down towards zero, marking the time when they would begin decelerating. "What's up?"

David gestured to a tiny video screen. Columns of numbers propped up the title InsertionCourse1. "Navigation came back online. We won't have to manually steer the insertion course; we can let the microchips do the thinking."

"What about the other systems?"

"I've just asked the computer to run a

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full diagnostic; the results'll be back any second. Damn, but this beats digging around with a voltage probe." The biggest video screen lit up, rows of numbers cascading down it. David touched a control and the avalanche froze.

"Let's see now," he said. "Attitude thrusters operational. Deceleration magnets operational. Liquid recycling and cargo heaters down. Food refrigeration down, cabin temperature sensors busted. None of those matter. Propellant feed, power couplings, heat shield sensors, landing parachutes: all operational. The radio's still down, but we're broadcasting position telemetry again."

Porter grinned. "We have what we need, then? We're good to go. Aren't we?"

David scrolled through the diagnostic screens. "We're—" He stopped, his mouth hanging open. "Oh, shit."

"What? What isn't working?"

"It's the inductor coils for the magbeam harness."

"The *whats*?"

"Little gizmos that fire the explosive bolts to break the contacts between the magbeam harness and the hull. They must have burnt out when the batteries discharged. We'll have to replace them."

"Why not just leave the harness in place?"

David shook his head. "Can't. It'd make us aerodynamically unstable. We'd burn up in the atmosphere. The coils've gotta be replaced."

"How long will that take?"

He frowned. "I don't know. I've never done it before."

"What? I thought you knew this ship!"

"This ship has over a million working parts. Those coils are about the least important of them."

"Not right now, they're not. Right now I'd say they're pretty damn vital. What are you going to do?"

"I'll have to get a look at one of the original coils, and help you make some new ones to match them."

"You want *me* to make them?"

"No choice. I can't do delicate work with my hand. But we're only talking about half a dozen metal coils, about the size of your finger. We've got three hours to replace them."

"What if I had a better idea?"

"Like what?"

"Screw landing on Mars. Set a course to dock with the platform instead."

David's teeth clenched. "We can't get to the surface from the platform. I can't fly their lander, and Beaume's in no state to do it for us. The sick people are on Mars. The medicine to save them is on this ship. We're going to Mars."

"You're going to risk crashing into the surface when we could dock safely with the station?" Panic tinged Porter's voice, and her eyes implored him. "At least dock for a few days to fix things. Then, if you're still bent on this kamikaze mission to the surface, you'd have a fighting chance."

"Their medical supplies have already run out. I'm not letting anyone else die waiting for us." He reached for her. "Vicky—"

She wrenched away from him. "Don't you dare call me that. You're going to get us both killed. We've got three hours, but what if we started on an insertion course and it turned out we couldn't fix the coils? We wouldn't be able to change course to dock with the platform, would we?"

She read the answer from his face.

"So, we'd be plunging down toward Mars, knowing we were going to burn up and not a damn thing we could do about it. Right?"

"Six little coils, Porter. Will you let them say we were beaten by six little lengths of wire? That we gave up after coming this far?" He nodded at the mission clock. "Three minutes until deceleration starts. Time to make a choice. Are you going to go for the knockout?"

She paused, frowning at the navigation computer. He could see the play of

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emotions across her face.

"I'll make your damn coils," she snapped, and stormed out of the cockpit.

Stifling a smile, David punched the Execute key to start the insertion program and trailed her back through the ship.

He felt weight return as the deceleration began, and for the first time in a month, "up" and "down" meant something again. At first he felt crushed, even though it was barely a quarter of what he carried every day of his life. After so much time watching Porter fumble around in weightlessness, it was a surprise to recall how gracefully she moved with gravity on her side.

He levered the access panel open. The metal tunnel beyond was barely wide enough for his shoulders, and with only one hand, he needed Porter's help to pull himself into it. He pushed a flashlight between his teeth, and crawled.

Fifteen minutes later, he dropped a melted and blackened wire coil onto the galley table. "We need to make six copies of this. It's just a copper coil with connections soldered on, but the dimensions need to be just right. The problem will be reinstalling them; we'll have to fit three each to save time. They're tricky to get at, along tunnels around the ship's perimeter."

"How do I find them?"

"I marked up the first tunnel with tape arrows while I was fetching this; the others are all the same. But let's get started making the coils; I'll explain as we work."

Porter proved adept at twisting the copper wire into the correct spiral shape, but the connections were fiddly and intricate, and her soldering needed constant supervision. After an hour, they were only onto the third coil.

"Hold the iron to the wire for a few seconds first," David said. "The solder'll flow better when you—" He stopped as the buzz of an alarm reached his ears. "Damn thing," he said. "It went off while you were on EVA. It kept stopping whenever I tried to find it. See—it's stopped already. Can't be anything important."

Porter swore as the alarm went off again, making her slip. This time it didn't stop, but kept sounding insistently. With a horrifying jolt, David realized at last where it was coming from.

The alarm blared as Beaume's cabin door slid open, and a red light pulsed on top of the medical monitoring unit. The EKG trace should have shown its distinctive pattern of dips and spikes separated by long flat stretches. Instead, a continuous ripple played across the monitor. Other indicators told a story of failing respiration and blood pressure. Beaume must have been teetering on the edge of cardiac arrest for hours, tripping the alarm for a few seconds at a time. He lay on his pallet like a corpse, muscled chest sunken and unmoving, eyes staring blankly at the ceiling.

David seized the med kit and unpacked the defibrillator, then thrust an ampoule of epinephrine at Porter.

"Add that to his IV line and open the pump wide."

While she injected the drug into the line, he pulled the defibrillator paddles from the charge unit and ripped open a package of conductive gel with his teeth. Porter stepped in and squeezed the gel onto one of the paddles. The defibrillator beeped, signaling its readiness. David spread the gel on both surfaces, then forced them against Beaume's chest and punched the buttons in the handles. Beaume jerked violently, his massive shoulders gouging at the pallet, but only flat red lines trailed across the monitor. Porter strapped a respirator mask over Beaume's face and squeezed the bag, forcing air into the pilot's lungs.

When the defibrillator beeped its ready signal again, David traded places with Porter and sent another shock through Beaume's body. This time his heart sputtered back to life, showing

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regular beats interspersed with erratic ones. The blood pressure reading climbed slowly and shallow breathing registered on the monitor. David sagged, feeling suddenly old and tired.

Beaume went into arrest twice more during the fabrication of the coils, and each time he was harder to resuscitate, wasting precious minutes. David brushed sweat from his brow and glanced at his watch every few seconds.

Porter put down the soldering iron. "That's the last coil. How long have we got to install them?"

"Forty minutes. We'll have to hurry."

The medical monitor sounded again. Racing to the cabin, David arrived to see the heartbeat indicator jump, squiggle, and flatten. Porter loaded another ampoule of epinephrine in the IV line while he flipped on the defibrillator. As soon as it charged, he applied the paddles to Beaume. No luck. Blood pressure and respiration fell off the chart. Porter cursed as she struggled with the respirator. David added his own litany of malediction under his breath. On the cabin wall, the clock ticked ever closer to atmospheric contact.

David grabbed Porter's arm. "We've got to stop."

She shook her head. "We can still save him."

"There's no time."

"I'll stay with him."

"No good. I can't install all six coils in forty minutes." The defibrillator's beep interrupted them. *Might as well give the poor bastard one last chance.* David set the paddles in place and squeezed the buttons down.

"Time's up." He dropped the paddles without waiting to see the results, and hurled himself out of the cabin, towards the first access panel, with Porter on his heels. He handed her three coils and helped her into the tunnel. As she pulled her legs in and grabbed a voltmeter, the monotonous buzz of the alarm stopped, replaced by the irregular beep of a heartbeat.

Mars loomed large, a great, rusty disk filling the viewscreen from edge to edge. David muttered a silent prayer and pulled the magbeam harness release handle. The *McAuliffe* shook with a series of sharp cracks as the explosive bolts fired. Six red lights flickered, went blank, then turned to green. Weight vanished as the ship's drive floated free, and the view tilted as the *McAuliffe* oriented herself to meet the Martian atmosphere.

David turned to Porter, strapped into the cockpit next to him. "It worked. The harness is loose. The referee just raised our glove."

The viewscreen washed white, and a rumble of thunder drowned out Porter's reply as the aerobraking began. David closed his eyes while the ship shook and bucked around him, and the heat and the roaring propelled him back through the years, to a time when he'd stood in front of a crowd, tired and bloody but unbeaten, in a boxing ring under the desert sun.

A combination of fatigue and Martian gravity anchored David and Porter in their seats while they watched a tank-like vehicle roll across the rocky surface to meet them. The wind whistled softly over the *McAuliffe*, like a new father soothing a restless infant. A cloud of red dust roiled up from the vehicle's treads and spun away to the south, whirling off toward the star-crowned horizon of an alien world.

David turned his gaze to Porter. "Welcome to Mars, Vicky."

David fastened his seatbelt and gazed out at the disk of blue and white visible through the shuttle window. In a few short hours, he and Porter would be landing at Dulles spaceport to face more cheering crowds. In the evening, they were due at a presidential dinner. It seemed like the whole world had lis-

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tened to his emergency broadcast, prayed for the fate of the colonists, watched through the Martian cameras while they landed.

But however much the public and media trumpeted his supposed heroism, six months after the fact, saving the Martian colonists seemed a hollow victory. David couldn't shake the feeling that Ellen should have been there with him. On arriving at HEO the day before, he'd found Gin waiting—waiting to deliver his decommissioning papers. He'd passed the mandatory retirement age for active space duty during the flight home from Mars, and was sentenced to a life's imprisonment on the surface of the Earth, with no right of appeal. He'd boarded the shuttle headed for LEO after only a few minutes' good-bye. She'd leave for Mars soon, to take up her new post as Colony Coordinator. She'd be fine, he was sure. They'd probably exchange messages at first, then she'd become too submerged in the work to remember him, casting aside her old life in the Space Transit System for a new one in the colony.

Beaume had survived. STS was set to settle quietly to prevent any claim of malfeasance, even though the inquest suggested Beaume's own careless attempt at a battery check had caused the accident. He'd soon be sitting pretty in some tropical paradise on Earth, surrounded by beautiful women who only wanted his money and not the cripple in the wheelchair. David didn't envy him.

"You're drinking in that view like it's a desert oasis."

David turned his attention to Porter, still fumbling with the straps of her harness. She'd never mastered weightlessness despite all the long hours traveling to Mars and back. He reached over to help her.

"Thanks." She flashed him a smile and glanced out of the porthole. "These presidential receptions are only one-night stands. You'll be back up here before you know it."

The mournful look on his face must have revealed the truth.

"You're not coming back, are you?" she said. "Oh, David, I'm sorry. I know how much you love it out here. What will you do?"

"I don't know. I'd like to make sure that Christa McAuliffe, Ellen Francis, and the two colonists who died on Mars aren't forgotten when some new president decides to pull the plug on the space program. Perhaps I'll do the rounds of the talk shows, let Hollywood make their vid of my life story, and advocate like hell for more space investment while people still remember who I am."

"Hm. Fame's a fleeting thing, and fans can prove fickle in the long run."

David looked again out the window. "The '26 elections are coming up. I could file for the Senate seat left vacant after Senator Ferrera's heart attack. A senator could be a powerful friend to the space program. I've never really seen myself as the Washington type, but maybe I should strike while the iron's hot."

Porter lifted an eyebrow. "And your kids at the gym? Your grandchild? Will you still find time for them?"

"Wyoming's a short hop from Washington by scramjet. Besides, how much more good could I do from Congress? Keeping space open as a possibility for those kids is just as important as what I do at the gym. What will you do when you get back?"

Porter gave him a crafty look. "I've been offered a promotion from Assistant Director of my division to Associate Director of Technology."

"Sounds impressive."

"One step below the top; without even a spell as Deputy Associate Director first. And the director's already made it clear he won't stay for a second term when the president carries the '28 elections. I'll be nicely positioned to move into the open slot."

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"So the headlines helped a little, did they?"

She blushed.

"The president is bound to ask your opinion of the space program at the dinner tonight," David said. "What will you tell her?"

"Well, I didn't find anything significantly wrong with STS, however much I wanted to. There's no indication of malfeasance, fraud, or inefficiency. The only problems are down to underfunding. It'll be up to her to decide what to do with my report. What will you advise her to do?"

David narrowed his eyes. She was getting at something. "I'll tell her to back the Mars colony one hundred percent."

Porter nodded. "And what will you offer her in return? It would be political suicide for her to resist expanding the Mars colony transport system right now, but with all the attention you'll be focusing on disaster contingencies, and her '24 campaign promises about building arcologies, she'll need something to demonstrate her commitment to people stuck here on Earth. She also has to balance the budget. You'll need to offer her something of equal value."

He shook his head in confusion. "Give me an example."

"Tell her to pull out of the US/EU Jovian expedition and use its budget to build arcologies on Earth."

"The Jovian expedition is the next step toward colonies at places beyond Mars. I can't recommend it be cancelled!"

Porter snorted. "Amateurs. Always thinking they can have it all. If you want to survive more than five minutes in Washington, learn that life is about compromise."

David opened his mouth, closed it, then nodded ruefully. "All right, I'll do it. I'll recommend postponing the new Jovian expedition in favor of expanding the Mars colony."

Did he detect disappointment? Porter's face settled into the old, frosty look he hadn't seen since their landing on Mars. David gazed out the window for a few moments. "We can launch the Jovian expedition much more economically from an independent Martian colony, anyway."

Beside him, Porter shook with peals of laughter.

Jodie looked out the shuttle window at the receding Earth, thankful that her husband and son were waiting safely on Mars to begin their trip to the new colony on Ganymede. Below, a cancerous black cloud obscured half of Montana and most of Wyoming, blanketed South Dakota and Nebraska, then crossed the Mississippi, creeping relentlessly eastward. The eruption of the Yellowstone supervolcano was only eleven hours old, but already death tolls were rising. The vulcanologists didn't know when it would stop, or how much of the world would be left.

She glanced down at the pamphlet in her hand, read her grandfather's name on the cover: David William Longrie. She'd attended his funeral service with her mother only the day before. So many years spent as a champion of the space colonization effort, warning against an event exactly like the one occurring now. At least he hadn't perished in it the way his own father had died in the '21 eruption. How ironic the eruption should start on the day of his memorial service.

Jodie's gaze returned to the window. She hoped her mother would be safe in the arcology under Mexico. The evacuation of the selected few was underway, starting the week before when the first rumblings sounded deep beneath the earth. That nice doctor who'd given her mother the arcology lottery ticket five years ago had attended the service as well. Jodie couldn't remember her name. Although elderly, she'd been ramrod straight, a quiet pillar of strength among the mourners, paying her respects to a great man. ■

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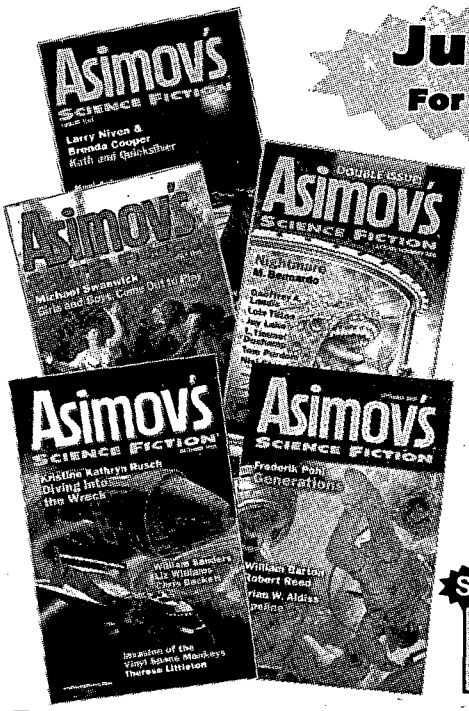

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Science Fact

Solar System Commuter Trains:

MagBeam Plasma Propulsion

James Grayson & Kathy Ferguson

In the age of the Internet, when communication moves faster, when cramjet technology makes it possible to be anywhere on the planet in a matter of hours, we still don't have the ability to investigate our nearest planetary neighbors in anything less than years, and then only when the planets are in optimum alignment. With the success of SpaceShipOne, the first reusable manned spacecraft to reach orbital altitudes twice in a two-week period, we stand on the cusp of a new age, where getting people and supplies into orbit may become as commonplace as flying from New York to California.

Once we reach orbit, how do we travel around our own neighborhood and beyond in a safe, fast, and cost-effective manner? Because of the risk and immense up-front cost of even a single manned space mission, off-world colonies and interstellar travel have long been regarded as pipe-dreams by the astronautical establishment. But, at the annual meeting of the NASA Institute for Advanced Concepts (NIAC) in March 2005, Professor Robert Winglee, of the Earth and Space Sciences Department at the University of Washington, proposed a new kind of ion propulsion system that may make fast solar system travel and interstellar exploration a reality, a system that could allow astronauts to make a round trip to Mars in less than a hundred days [1]. He calls it MagBeam.

Ion Propulsion Systems

When a gas—usually argon or xenon—is sufficiently energized, electrons are stripped away from their nuclei, and the gas becomes charged (or *ionized*). Because of its charge, this cloud of ionized particles (or *plasma*) can be accelerated to very high speeds (tens of kilometers per second) by exerting a force on them with an electric or magnetic field. If these fast-moving ions are directed out of a spacecraft, they impart a force to the spacecraft according to Newton's Third Law. This approach does not produce very high levels of thrust, but it does have much lower fuel consumption than traditional chemical rockets, allowing ion drive spacecraft to continue accelerating for

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much longer periods of time. Thanks to the very high speed at which the ions are ejected, ion thrust is ultimately capable of propelling a spacecraft much faster than chemical propellant drives.

Using a stream of ions to propel a spacecraft is not a new concept. It was used in the Russian Zond-2/1 satellite in 1964, and the USAF/TRW Vela/2 craft in 1965[2]. Satellites presently in orbit around Earth use ion propulsion to keep themselves in position and prevent their orbits from decaying over time. On a larger scale, the Deep Space-1 (DS-1) vessel, launched in 1998, used an ion drive for its flyby of the asteroid Braille and Comet Borrelly, while the Dawn mission will carry three separate ion drives for its flyby of Vesta and Ceres when it sets off in May 2006 for the asteroid belt beyond Mars [3,4].

Helicon Plasma Propulsion vs. Electrode Ion Drives

All of the systems on these spacecraft use what are known as electrode ion drives. The typical design is called a gridded ion drive [2]. These use an electron source to energize the fuel gas, splitting it into negatively charged electrons and positively charged ions. A metal grid, held at high voltage, attracts the positively charged ions, which pass through the grid and out of a nozzle at high speed, creating thrust for the craft. Meanwhile, the electrons are gathered and reintroduced into the exhaust to neutralize it and prevent charge building up on the spacecraft. The voltage of the grids can be adjusted to vary the thrust, varying the velocity imparted to the ions.

The problem with this approach is that to get the high levels of thrust needed to move larger payloads, the power requirements and grid sizes become so large that they're no longer practical [5]. And, as the level of thrust is increased, the grid electrodes begin to erode, limiting the useful lifetime of the system.

By contrast, the MagBeam system proposed by Professor Winglee uses a helicon plasma source to create thrust, rather than a gridded ion drive. A helicon consists of a quartz tube with a radio antenna wrapped around it [6], into which gas is injected (again, usually argon or xenon, although almost any gas can be used). Radio frequency (rf) electric currents are passed through the antenna, and the rapid variation of the electric field ionizes the gas. The ionized gas is then accelerated by electric or magnetic fields to produce thrust.

The helicon technology has several advantages over gridded ion drives. First, it produces more efficient ionization than a gridded system, resulting in a much denser plasma, which can produce much more thrust. Second, while a gridded electrode system has to grow in size in order to produce more thrust, a helicon system can simply use more power to produce more ionization. For example, a gridded ionization system with a 40-kW power source would need to be 5 to 10 times larger than a helicon system using the same power source [7]. This compactness is of great benefit in space missions, where every kilogram of mass has to be paid for in extra fuel consumption. Finally, because the ionized gas never comes into contact with the antenna producing it—the system has no electrodes—the helicon system does not experience the erosion that limits the lifetime of electrode ion drives, and has an essentially infinite lifetime.

Helicons, with their potential for increased thrust and decreased wear, have obvious advantages over electrode ion drive systems. However, another property of the helicon technology is even more important for the MagBeam system. Most ion drives produce quite broad plumes of exhaust, but if the exhaust doesn't hit the spacecraft superstructure, no one really cares about the dispersion. In MagBeam, however, the helicons produce a much tighter beam of ions, because the magnetic field that accelerates them is "frozen" into the

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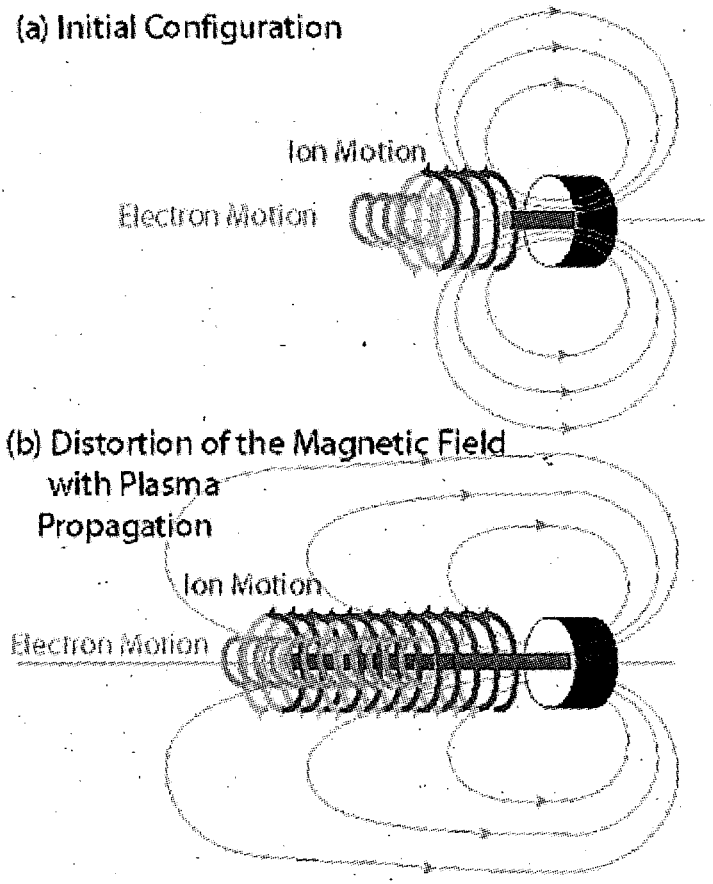

Figure 1 (image used courtesy of Robert M. Winglee): Magnetic field distortion with MagBeam propagation.

plasma and carried along with it, creating an elongated magnetic field continuing out into space. (See Figure 1.) When a focusing magnet is used, the result is a tight beam with very little divergence, much like a laser. Even in a conventional system, this is a significant advantage; it can yield an improvement in efficiency of about 50% over normal ion drives [1].

In MagBeam, though, the dense, focused beam is crucial to how the system works. That's because, in MagBeam, the helicon doesn't push itself through space, but sends its ion beam through space to push other spacecraft. So, how does this translate into more efficient space travel?

How the MagBeam System Works

In the January/February 2004 issue of *Analog*, Gary Lai reported on efforts by Professor Winglee's team to produce a craft (dubbed the "M2P2" for Mini-Magnetospheric Plasma Propulsion) that used a giant magnetic ion bubble to extract thrust from the solar wind—the stream of fast-moving ionized particles that flows outward from the Sun [8].

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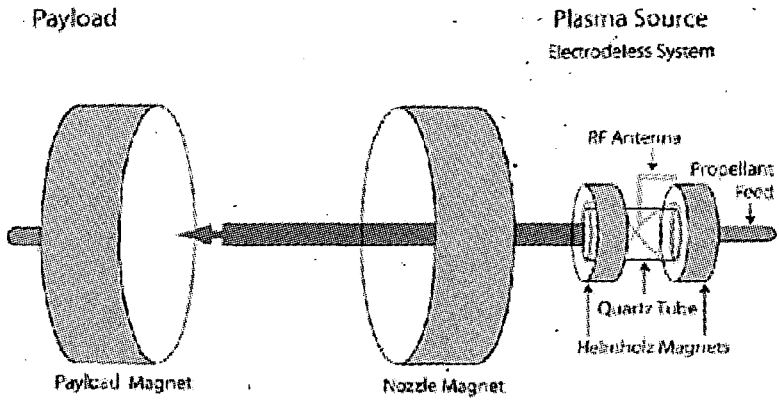

Figure 2 (image used courtesy of Robert M. Winglee): Schematic layout of MagBeam system.

This concept, while interesting, proved impossible to demonstrate adequately on the ground because of the scale of the testing facilities required [7]. Technologies that cannot first be proved on the ground cannot be included in space test missions. However, the limited, on-ground testing stage of that project sparked an idea for a new and different propulsion system, with potentially revolutionary capabilities: MagBeam.

While the University of Washington group was testing the M2P2 prototype in the laboratory, they conceived the idea of using a plasma thruster to imitate the solar wind. The solar wind is itself a plasma, although very much less dense than that produced by any kind of ion drive, so using a plasma source to simulate it was a natural decision. This experiment inspired the idea of using a plasma source to beam energy across space to an unpowered spacecraft and became the basis of the MagBeam system. It works like this:

Professor Winglee proposes the use of orbiting platforms carrying high-power helicons, each able to focus a very dense ion beam with a power of about 300 megawatts onto a transport spacecraft from a distance. These transport craft carry a small store of a gaseous propellant, such as argon or xenon, and a set of electromagnets, in addition to a small power source and a payload. The propellant is ejected into space, where it is heated and ionized by the incoming plasma beam. This ionized gas is then repelled by the electromagnets, imparting thrust to the craft in reaction. (See Figure 2 for a schematic of the system.) A good analogy is driving a floating bottle along by splashing stones in the water just behind it. The platform carrying the helicon remains in orbit, pushing the spacecraft away at high speed, while a similar platform at the destination uses its plasma beam to slow the vessel down again when it arrives.

Unlike the earlier M2P2 project, where the force of the solar wind against the ion bubble was always directed away from the Sun, a MagBeam system can impart thrust in any direction simply by having the target craft eject the propellant gas in a different direction (or, in the analogy used before, splashing the stones on the other side of the bottle). A large bubble or sail area to intercept the plasma beam is not required. The payload spacecraft doesn't have to carry a massive power source or

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large store of propellant, because all of this equipment is on the orbiting platform instead. The energy for propulsion is beamed to the vessel through space, rather than being carried with it, making it far lighter than any existing craft can be.

Because of this, MagBeam imparts rapid acceleration to the departing spacecraft, on the order of 1 ms^{-2} [7]. This may not sound very large—the equivalent of a car taking about twenty-five seconds to reach sixty mph—but it's far higher than other ion drive systems. By comparison, the solar-powered ion drive on DS-1 provided acceleration about ten thousand times smaller. Proposed nuclear-powered craft, such as VASIMR [9], do about ten times better than solar powered systems, but still accelerate a thousand times slower than MagBeam.

A logical question might be "How does the beam remain targeted on the vessel?" With such high accelerations, the distance of the vessel from the platform gets very large very quickly—reaching as much as 150,000 km for the longest anticipated accelerations. This isn't expected to be a problem. The plasma beam is like a stroke of lightning. Lightning is a very coherent beam of plasma that seeks a region of high conductivity to transfer excess energy from a cloud to the ground: that's why smart people don't fly kites in thunderstorms. Our magnetized beam behaves in the same way.

The payload out in space acts as a lightning rod, and the plasma beam is essentially the same as an electric current, with the magnetic field it drags along acting similarly to a wire. Space itself is pretty much empty, and therefore of low conductivity. When the beam is turned on, it makes an electrical contact with the payload near the station, and then it's just like paying out a transmission line as the vessel moves away. The beam stretches out between the two regions of high conductivity (the platform and the payload) until it's turned off at the platform. Electricity always seeks the path of least resistance, and so the plasma flows along the conductive path traced out by the retreating vessel, confined by its inherent magnetic field.

Once the spacecraft has been accelerated, the beam is turned off, and the craft coasts toward its destination at very high speed—as much as 20 kms^{-1} for a 50-day trip to Mars. This is faster than any human vehicle has ever traveled, including the Voyager probe with its multiple gravity assists over several years. On arrival, of course, the MagBeam vessel has to brake, or it would shoot past its destination and never be seen again. The MagBeam system uses another platform on the opposite end of the journey to provide the thrust to brake.

Braking is more difficult than acceleration, because there's no conductive path between the platform and the payload for the plasma beam to follow. So, the platform at the destination would have to be activated when the spacecraft was already quite close to it, then be run at higher power than during acceleration to get in the same amount of energy in a shorter time. However, once the connection is made, the vessel uses the same thrust system it used for acceleration to brake by simply deflecting the ionized gas ahead of itself instead of behind.

Advantages and Risks of the MagBeam System

One useful way to think of the MagBeam system is to compare it to an electric train. Huge generators and transformers are needed to produce the electricity to power such a train, but none of this equipment is carried on the train itself. If it were, the train would be so heavy that it would hardly be able to move. Instead, the electricity is transmitted to it through the electric rail—just as it's transmitted through space in MagBeam—and can not only power the

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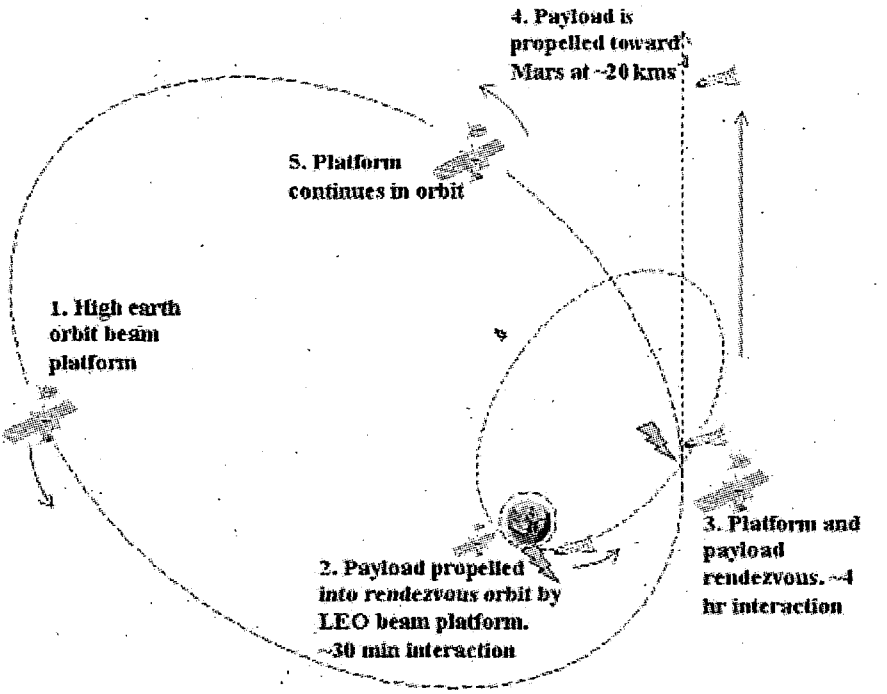
4. Payload is propelled toward Mars at ~20 kms
5. Platform continues in orbit
1. High earth orbit beam platform
3. Platform and payload rendezvous. ~4 hr interaction
2. Payload propelled into rendezvous orbit by LEO beam platform. ~30 min interaction

Figure 3: Schematic of MagBeam propulsion for a fifty-day mission to Mars.

train to much higher speeds, but allow it to carry more cargo in place of the generators.

In a conventional system, where the propulsion system and propellant are all carried on the payload they are propelling, the acceleration potential for the payload is reduced because of the mass of the propulsion system (as much as 80% by mass of the Deep Space-1 vessel consisted of propellant, propulsion system, and power supply [10]). The MagBeam system transport spacecraft will be much lighter than the platform that carries its propulsion system [7], and so can be accelerated much more rapidly and to much greater speeds than any spacecraft that carries its own propulsion system on board.

The amount of time the platform needs to beam energy to the craft is quite short—as little as five minutes to transfer a ten-ton payload from suborbital altitudes to a low earth orbit, or thirty minutes to propel it to geostationary or escape velocity, according to Professor Winglee's calculations [1]. For maximum flexibility, the system uses two platforms: one in a low Earth orbit (LEO), and one in a much higher orbit. Payloads are raised to sub-orbital altitudes using standard launch methods (such as those used for SpaceShipOne), and then the LEO platform takes over. The LEO platform propels the payload into low Earth or geostationary orbit, or even to escape velocity for a trip to the Moon. For longer missions requiring higher speeds, such as a trip to Mars, the higher orbital platform is used to provide additional acceleration. (See Figure 3.) Longer interaction times are nec-

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essary to achieve the higher speeds for interplanetary travel. To achieve these, a higher orbiting platform is required, so that the Earth doesn't get in the way during the interaction.

In addition to the fast accelerations and high final speeds MagBeam offers, the savings in terms of fuel are also significant. Professor Winglee predicts that for MagBeam to send a ten-ton payload to Mars in just fifty days, only a four-hour interaction time and a total of seven tons of propellant are required. Carrying out the same mission using today's conventional rockets would require an enormous 18,000 tons of fuel. The potential of MagBeam is obvious.

Currently, space missions operate using a "one power plant, one rocket, one mission" paradigm, where all the expensive propulsion hardware on a deep space vessel is lost after one mission. Not only does it cost money to keep building new power plants for successive missions, but it costs on the order of $10,000 per kilogram just to get them into orbit. The MagBeam system, by using an orbiting propulsion platform with an effectively infinite lifetime, and propelling a succession of small, reusable, unpowered or low-powered craft, would reduce hardware costs radically in the long term.

The MagBeam system would require a large initial investment to build the platforms and associated infrastructure (an estimated $10 billion at present to launch a platform capable of sending that ten-ton payload to Mars in 50 days [7]), but repeated missions would bring vast long-term savings over more conventional propulsion systems. This is partly due to the far smaller propellant requirement and partly due to the reusable nature of the orbiting platforms.

Having platforms at both ends of proposed journeys is a key element of the MagBeam system. Unfortunately, while the system would provide drastically reduced trip times once in place, currently no way exists to get the destination platforms into place quickly. To propel a spacecraft, the MagBeam platform will need to be between 20 and 100 times more massive than the craft it pushes [7]. Positioning this much mass around Mars will still require longer trip times, using conventional propulsion methods. If we continue the analogy with a rail system, this is equivalent to the time and cost of laying the tracks and building the stations.

However, adding MagBeam capability to facilities already in orbit could be relatively simple. For instance, if an orbital station already existed around Mars in support of manned exploration, a MagBeam platform could be attached and powered, making fast trip times possible. The equipment to produce the plasma beam is relatively light—the great bulk of the mass comes from the batteries or other power supplies needed to operate it. For example, to carry out the four-hour acceleration required for the 50-day trip to Mars, the platform would require about 3,000 tons of batteries to power its 300-megawatt thruster. This seems like a lot, and indeed getting an equivalent mass to Mars by conventional means to carry out decelerations would be expensive. But once in place, these battery systems could be recharged indefinitely via solar power, so the cost would be a one-off capital investment. Better still, even conservative estimates suggest that improving battery efficiencies in the next decade could bring the weight requirement down by as much as a third [1].

If MagBeam has a downside, it comes from the high speeds that the spacecraft obtain.

"You're traveling at high speed," Winglee told us, "so anything at high speed is going to be more dangerous *per se* than lower speed. On the other hand, if you go out at low speed, you end up with a whole lot of biological dangers. So we're swapping biological hazards for physical hazards. If you make a mistake

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at 20 kms^{-1} vs. your standard 7 kms^{-1}, it's going to make a bigger change. Would it still be safe? We try to keep it as safe as possible insofar as you guide the system and make course corrections, but once you're up to speed, you're up to speed, and you have to wait to the other side to make course corrections because the speeds are so high."

Implications for the Future

The validity of the MagBeam idea has been proved in the laboratory, and plans are afoot to expand the testing to larger scales. At the NIAC conference in March 2005, Professor Winglee expressed his hope for a space-borne test as soon as 2009. Even though a MagBeam commuter system doesn't yet exist, we can still speculate on what it might mean to the manned and unmanned exploration of the solar system, and to robotic flights to nearby stars.

We've seen a pattern throughout history of the expansion of civilizations as transportation to new lands becomes cheaper and easier. Humans first migrated to North America because the land bridge between Alaska and Siberia made it possible. When the land bridge was no longer available, Europeans took to the seas and sailed to the new world, where expansion took place first on foot, then by covered wagon, and eventually by rail. During the Great Depression, automobiles made possible the huge migrations of Midwesterners to California, where people searched for new opportunities. Today, many people on the eastern seaboard use commuter trains to get from their homes to their jobs, covering distances daily that would have awed the early colonists. This would be impossible without inexpensive, dependable transportation.

MagBeam should not be seen exclusively as a method for reducing trip times to distant locations in our solar system. A platform in a low Earth orbit could be used to modify the orbits of satellites or space stations, and also to boost payloads headed for the Moon—all far more cheaply than currently possible. For example, a platform on the Moon could be used for returning rock sample containers to Earth far more economically than dragging chemical propellant and rockets to the Moon for the purpose. A platform in Earth orbit would decelerate the Moon samples, and insert them for re-entry. When combined with inexpensive orbital launch techniques, the possibilities for an expanded presence on and commercial development of the Moon become financially much more attractive, both for businesses and for tourists.

Although the need for deceleration platforms means that the MagBeam system would not allow us to reach distant destinations any sooner than existing methods, it would allow for much cheaper, more rapid repeat journeys. Instead of being hugely expensive single endeavors as they are now, trips to Mars or the outer planets could easily become much more commonplace. For example, the unmanned Mars Exploration Rover Mission took six and a half months to arrive on Mars [11], while a MagBeam system, once implemented, could have a crew there and back in just 96 days, including eleven days on the surface. (See Figure 4.)

Successful colonization of distant places like Mars hinges on an easy system of re-supply until such time as the colony can become self-sufficient. With our present technology, we can only launch missions to Mars about once every two years, when the planets are in the proper alignment. However, with the kind of acceleration MagBeam could impart, we would no longer have to wait for those brief windows of opportunity to send people and supplies. Although trips at times when the Earth and Mars are not aligned would take longer than the 50-day trip described by Professor Winglee, they could still be made in relatively short amounts of time and at very low cost compared to those

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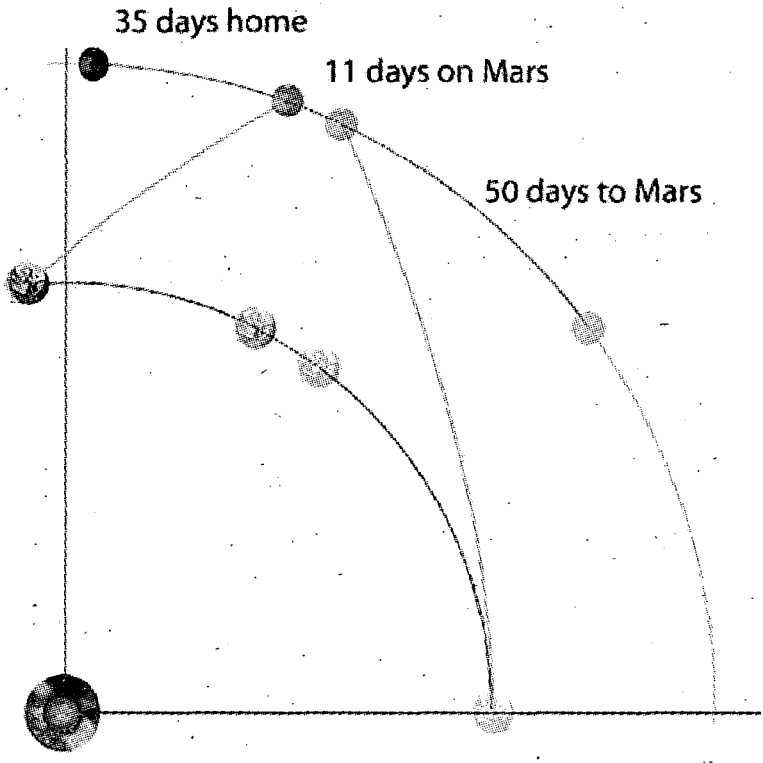

Figure 4 (image used courtesy of Robert M. Winglee): Orbital schematic of 96 day Mars return trip.

fueled by other means.

Far distant locations such as Jupiter or Neptune are currently not considered plausible destinations for manned missions because of the extensive travel time involved, and scientific missions taking more than ten years to produce data are rarely considered useful. However, if MagBeam can reduce the travel time to Jupiter from ten years to a year and half, travel to these places by humans becomes more enticing. And before humans go, an Earth-orbital MagBeam platform gives us the chance to launch larger and more frequent robotic science missions at vastly reduced cost, so we'll be better prepared when we do set forth.

Another exciting application for MagBeam could be accelerating interstellar probes. MagBeam has the capability to accelerate robotic probes to much greater speeds than those attained by any craft to date. Additional speed could be obtained by using successive platforms at distant locations such as Mars and Jupiter to boost the probes' speed as they head out of the solar system, greatly reducing trip times to the nearest stars. Any such trip would probably still take centuries, but the prospect is an exciting one nonetheless.

Like the commuter train, MagBeam offers humans the chance to expand the neighborhood and explore new places, yet still remain in close touch with our

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roots on Earth. Professor Winglee sums it up succinctly.

"Yep, you could do that. You could really have some fun."

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Original Sin

Richard A. Lovett

Any tool can be put to alternative uses, some of which are . . . tempting.

Eight thousand meters isn't really all that far to run. But it can be a hell of a long way to race. Especially on a tough cross-country course like this one, where mud and hills turn the legs turn to jelly until, by the final circuit, you're running solely on willpower.

I knew. It was my second time through, feeling that I was on the ragged edge of collapse but continuing, nonetheless. I'd run the race of my life the first time. Now, I was doing it again, for Dylan.

I was doing it because nobody had faulted him when at fifteen, he'd coasted to first place in the Wyoming high school championship, then won again and again and again. Instead, they'd rewarded him: running was now paying his way through college.

Last year had been more of the same under the coach who'd preceded me. But no longer. Not if I had anything to say. Today, Dylan couldn't slow down. He would have tried by now and found it didn't work. Hell, at the start of that final lap, *I'd* tried. But I'd just kept on running, like an out-of-control Energizer bunny: going and going and going.

How much longer? Four minutes? That would be about 700 steps. Seventy would be a tenth of the way. I could imagine keeping up the pace for that much longer—barely. Once, Dylan had admitted to thinking that way in practice, when I pushed him harder than any coach ever had before. Now I could hear him, softly counting. "Cut that out," I said, and he gasped at the unexpected sound in his ear.

I felt as though I should be wheezing from the effort, but my voice was nearly normal. "You're trying to disengage," I said, "but you have to stay in the moment. Welcome the pain. Tell yourself you're going to punish the parts of your body that hurt by make them hurt more. That's what real racing is about."

Ahead, the course slanted into a ravine. It was a good chance for a breather, but we sped downhill, barely on the edge of control, legs and lungs working as hard as ever. At the bottom, a

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slight stutter-step set us up to leap a narrow creek with dry feet, then we were dashing up the other side.

"The finish is at the top," I said. "Now is when great racers run like there's no tomorrow. None of that half-assed, cruise-in-for-the-cameras crap you've been getting away with all your life. This time it's going to be the real thing."

Not that he had any choice. We were *in what, in our present condition*, passed for a full sprint, dashing uphill. It felt like running through molasses, but the runner we'd been shadowing for the last 800 meters—the one with the fringe of salt-and-pepper hair surrounding a Friar Tuck bald spot—didn't have what it took and we shot by him like he was standing still.

Now we were at the top, and there was the finish line and the clock. Dylan gasped again, and it took me a moment to figure out why. Then I realized that the time was, for him, far too slow. *Minutes* too slow. It was a good finishing time for me—a spectacular one, in fact—but there was no way Dylan could work so hard and not be a lot faster.

For the moment, though, it was enough to be across and no longer running, gasping for air that still would not come fast enough, walking—pacing because if we didn't keep moving, we'd keel over in a dead faint. Except, of course, that I was the only one who'd actually run a race like this anytime in his life. The only one who'd truly been at risk of fainting, because Dylan always finished looking as though he could do it over again—always held something back because he didn't *want* to look like this at the finish.

He was saying something, but I couldn't catch it. Most likely, he was still confused about the time, because the illusion was so gripping that the first time you tried it, it was hard to remember what was really happening.

I cut the feed and finally there was enough air. In fact, there was a lot of it, and we were no longer pacing. We were sitting in my office and I was unjacking the virtual reality players that had been so unbelievably good that halfway through, I too had had trouble not believing I was out there in the grass and mud and that it wasn't my lungs, or at least not my lungs in the here-and-now, that were about to explode. As it was, my pulse had quickened and I was bathed in a thin sheen of real sweat. I could even swear that I felt residual fatigue in my legs, though that had to be simply an afterimage of the VR, which had been more real than any game program Dylan would ever have encountered: so real it had never crossed his mind that he could make the whole thing end simply by ripping off the headset and telling me what he thought of my little "experiment" in racing strategy.

But now he was thoroughly back in the present. "You tricked me!" he protested, as though coaches hadn't been tricking athletes since the dawn of sport.

I grinned. "No permanent harm. I wanted you to understand how much you'd been slacking. Just because you're fast doesn't mean you're anywhere close to your potential."

"But who cares, if the time sucks? I could *jog* faster than that. Who the hell was I, anyway?"

I could feel the grin stretching. "Me. Last weekend, in the national masters championships, with an honest-to-goodness gold medal on the line." The medal had only been in the 55-59 age group, but that was beside the point. It's been a while since I could keep up with the forty-year-olds.

I didn't add that the decision to record the experience might have made the difference between gold and silver. I'd never beaten Friar Tuck before, but I'd known I couldn't show Dylan the recording unless I went after him with everything I had. "Learn to race like that and you can take it to the next level. Maybe even beat the Kenyans in the Olympics. Continue backing off from

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the pain, and you'll never truly amount to anything." I let that sink in. "As for the gadget, it's a VR trainer. A friend made it for me, and I used it to record my race."

Dylan didn't ask where the device came from, and I didn't tell him. There is an old thought experiment, called "six degrees of separation," which postulates that nobody on the planet is more than a half-dozen "friends of friends" removed from anyone else. I have no idea whether it's correct, but if it is, it must rely strongly on what I think of as nexus people: those whose connections run in multiple, unexpected directions.

I'm one of them. I've always been into athletics—running paid my own way through college—but the connections that got me the VR gadget involved basketball and computer games. Last summer, I'd been complaining to my old college roommate, Derrick, that the basketball team could have won the NCAA tournament if only it could shoot free throws. I'm not sure exactly what I said—multiple beers had been poured and I was merely telling him about my new job and the school's overall athletic prowess. But six months later, the headsets arrived. They came with a recording of some NBA star doing his thing at the free-throw line, and by the time I'd played it a few times, I felt as though I could hit nothing but net every time.

Derrick didn't know the basketball coach and asked me not to show him the headsets. But I'd also told Derrick about Dylan and his Olympic potential. Officially, I was beta-testing the interface for a hush-hush video game. Unofficially, I was living a coach's dream.

Coaches have always wished they could read their athletes' minds. Now I could do the next best thing, because one of the headsets doubled as a recorder.

"Do you want a shot at the Olympics?" I asked.

Dylan nodded. What athlete didn't?

"Then I want you to wear this thing during workouts and races." I handed him the recorder, a nicely miniaturized contraption about the size of a music player. I showed him how it worked and handed him one of the recording chips. "Bring this back next week." Distance runners by necessity do a lot of their training out of sight of the coach, but with the headset, I could monitor every step he took. It really was a coach's dream.

That week, Dylan showed a new fire in his training. He'd always been the fastest on the team, but never the emotional leader. Now I wondered whether he might mature into next year's captain. It was hard to tell because Dylan had a lot to learn, not just about running but about emotional maturity, and the chip didn't really allow me to read his mind. It merely captured sensory inputs.

The collegiate cross-country season had ended several weeks before my masters race, so we were now gearing up for track, where Dylan's event was the 10,000 meters. As the weeks progressed, he continued using the chip, but now he seemed to have two modes. One was the slacker, who always kept enough in reserve to look good to whoever might be watching. The other was new: an overachiever who did his workouts slightly faster than called for. I could shift him from one mode to the other by catching him at it, but it was like flipping a switch: "A" or "B," with no midpoint. That puzzled me until I realized that both behaviors represented the same thing. He was still showboating; he'd just found a new way to do it.

For Dylan's remaining collegiate career, the new mode wasn't necessarily a bad thing. But in the long run, that overachiever stuff is worse than slacking because it burns you out and increases the risk of injuries.

My job doesn't require me to worry about the long run. I'm paid to bring glory to the university by winning collegiate meets, not to train iffy Olympians. College coaches are notorious for wring-

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ing as much as possible out of their athletes during their years of eligibility, with no thought of what happens later, but I've never been one who could advance his own career over the bodies of the kids he's supposed to mentor. Call me altruistic; call me a fool. I'm either good enough to do both the paid job and the real one, or I'll find a new career. One advantage of being a nexus person is that I know how to do so, if necessary.

From the chips, it was obvious that Dylan's showboating was at its worst when the women's team was training at the same time. In retrospect, I should have addressed the underlying immaturity directly, but instead I chose to focus on his running. My theory was that if I could help him mature there, he would in due course do so in the rest of his life, as well. It's an approach that's worked for plenty of other athletes, but if there was ever a decision I wish I could reverse, this was it.

I began by changing his schedule to avoid the women. Then I told him that the best way to show off was by impressing me, via the chip. "What I want to see is discipline," I said. "The closer you can get to doing *exactly* what I tell you, the more impressed I'll be."

Every Friday, Dylan handed me that week's chip, and I spent my weekends playing back every minute of it. Since he ran eighty miles a week, that was a sizeable time commitment, but luckily my wife is the understanding type. Our daughter had gone off to college two years ago (on a track scholarship, what else?) and I was the one who most strongly felt the empty-nest syndrome. If I wanted to adopt Dylan as a special problem child, my wife was willing to humor me. Someday, I owe the woman a trip around the world, but probably not before I retire. Until then, there will always be some Dylan who I can't abandon for that long.

For a month, he ran strong. Then in the fifth week, I felt a pain in his right knee. He'd said nothing about it, but when it comes to injuries, athletes fall into two camps: hypochondriacs who fret that each twinge is the one that will ruin their careers, and macho-types who'll tell you they're fine, even when they obviously aren't. Dylan had never been a hypochondriac, and with me tantalizing him with dreams of glory, it was no surprise he'd gone macho.

One of the hardest parts of coaching is figuring out whether such injuries are worth worrying about, and there have been myriad occasions on which I'd wished I knew exactly what an ache or pain felt like. Now, I could. I played the chip over and over again, concentrating on how it felt at each part of his stride. Eventually I decided it was trivial, and the next week proved me right when the pain vanished as mysteriously as it had appeared.

But the experience set me thinking. A few days later I called up Derrick and told him the story.

"Can you imagine what it would be like if every doctor had one of these?" I asked. "No more, 'Does it hurt when I do this?' You'd just wear the headset, then give the chip to the doctor."

Derrick is the opposite of a nexus person, deeply wrapped up in his own narrow field. But that doesn't mean he has no imagination. "EMTs would love it, too," he said.

"Parents could use it with young children."

"Cops could screen drunk drivers."

That set off a brainstorming session that I cut short a few minutes later with a question that had been nagging at me ever since I'd played the recording of Dylan's knee.

"Would you really want to spend a whole day experiencing other people's pains?" I asked. It was one thing to play the chip of Dylan's knee pain again and again. It had never been more than a twinge. "That could get rather unpleasant."

"Yeah," Derrick said. "It needs a gain control." There was a brief silence, and I

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pictured him staring out the window, thinking through a nifty technological problem, like he'd often done back in our dorm room. "Intensity of playback was a problem in the first prototypes," he said a few seconds later. "The first was so powerful you could barely wrench yourself out of it before the end, even when it was something mundane, like looking out the window. Then I overcorrected, and got nothing more than a weird shadow image." He paused again. "It would be easy enough to make it variable. Good idea."

Two weeks later, Dylan ran his first race wearing the headset. He ran hard, though still not all-out. I told him so, and the following week he was better. Two weeks after that, he was better yet, and then we were on a roll until the NCAA finals loomed. The team had no chance—I'd recruited some good underclassmen but they needed another season or two to develop—but Dylan made the finals on individual merit.

This time, I told him not to wear the headset. It didn't weigh much, but in a 10,000-meter race each unnecessary ounce costs you half a second, and the headset weighed six ounces. Dylan would either do well or he wouldn't. Either way, the season would be over.

He was eighth, a major improvement from the year before. He'd have done better yet if he'd not ignored my advice and grabbed the lead in the first lap, where he stayed until he ran out of gas with a mile to go. It was another show-off move, but at least he was running hard, and we had all of next year to work on strategy. Overall, I was pleased. If he continued to improve, he had a shot at winning by his senior year.

It was now summer, and Dylan went back to Wyoming with the recorder and a stack of chips. For the next few weeks, his regimen was simple: keep running, but take a few weeks off from hard workouts. Perhaps that's why I wasn't overly dismayed when, on the first Friday, he left a voice mail message saying he had no chip to send me.

"Sorry, Coach," he said. "I seem to have misplaced them."

The chips looked a lot like the latest music and video cartridges, so I figured they were lost in a stack of look-alikes. I was out of blanks, but I didn't really need the ones we'd recorded during the winter and spring, so I erased a few, labeled them carefully as VR chips, and sent him enough to see him through the summer, along with a stern admonishment not to lose any more.

Meanwhile, Derrick sent me a new pair of headsets, with variable gain control. "I realize you're doing fine with what you have," he said, "but it was your idea, so I thought you might like to try it out."

"Do you want the old ones back?"

"Nah. Keep 'em."

As long as he was in a generous mood, I told him about the lost chips.

"No problem. I've got a whole boxful. It's the type of thing that once you make the first one, it's not a lot more expensive to make a thousand. How many do you want?"

I pulled a number out of the air and he promised to get them into the next day's mail.

As luck would have it, I'd not reused the chip that had recorded Dylan's sore knee. The gain control on the new headsets was a simple dial, with an arrow indicating what I presumed to be the high-gain end. The thing about prototypes is that nobody invests time in fancy labeling; all that matters is that the designer knows what the controls do.

Since there was some chance that the arrow indicated the low-gain direction rather than the high-gain one, I set the dial in the middle of its range and skimmed for the right segment of the chip. When I found it, the playback felt about like what I remembered.

I turned the dial down and the pain

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decreased. I turned it up and yelped. Dylan's twinge had become an excruciating stab, his stride was a pounding rhythm that hit like a sledgehammer, and his breathing felt like the chugging of an old-fashioned steam engine. The entire experience was also more intense—far more real than reality itself, but with a wrongness you didn't realize until afterward. If I'd not been playing back chips for months, I'd have sat there entranced until the playback ended.

Nobody needed a gain control with that wide a range, but Derrick had never been one to do anything by half-measures.

By August, Dylan was back on campus with the rest of the team, which needed to start practice well before the start of classes.

He showed up with a sporty new car—a nice little gas/electric hybrid. At the time, I didn't think much of it because track and cross-country aren't the type of sports in which rich boosters buy such things for the stars. Runners are much more likely to get into trouble over trivia, such as cash or merchandise prizes in summer road races—anything of sufficient value to turn them into professionals.

The main reason the car caught my attention was that it got me thinking about poverty. With gas prices heading toward ten dollars a gallon, the old gas-guzzlers have become dirt-cheap. That makes them the most common cars for students, even though most can barely afford to drive them. It's one of those ironic little poverty traps in which you can save a lot of money by buying a more efficient car, but only if you have the money to begin with. I wasn't sure how well-to-do Dylan's parents were, but his running was saving them a lot on tuition, so I figured they'd used it to give him a gift.

Then, as it is sometimes prone to do, life became infinitely more complex.

It began with a phone call from Derrick.

"I've been trying to reach you for hours," he began, breathlessly enough that he obviously believed every second mattered. "You know those VR headsets I gave you?"

"Sure. They've worked wonders for my runner. This year I'm hoping he'll—"

"Tell me some other time. I'm calling from a pay phone and I don't think anyone can trace me, but I don't want to talk any longer than I have to. I just want you to destroy them."

"What?"

"You heard me. I shredded all my files today and threw all of my own prototypes into the incinerator. You've got the only ones left."

"But it's a miracle. Dylan's—"

"I don't care! I've been stupid. Really, really stupid. I got a visit this afternoon from a pair of government types. They tried to search my office but didn't have a warrant and my boss managed to chase them away, but not before my secretary heard them tossing around a phrase that sounded like 'humane torture.' I'd never even thought of it, but that thing's too real. With the right recording, you really could use it for torture. If they want a gadget like that, they've got to invent it themselves. Don't let them get yours." Then there was a click and I was listening to an empty line.

It was Friday evening, and my wife and I had just come back from dinner and a movie. Dylan had one headset, but the others were in my office. Could this wait until Monday?

The trouble with miracle gadgets is that there's always someone who can figure out how to turn them to anti-miracles. My brother is a Baptist minister and he's always talking about Adam and Eve, original sin, and human depravity. I suspect that this tendency to create anti-miracles is exactly what he means, but when we try to discuss such things, we don't speak the same language, so I'm never sure.

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One thing I was sure of was that the baddies wouldn't wait. I sighed and decided I probably shouldn't, either.

The headset and chips were right where I'd left them. I probably could have waited until Monday, though Derrick and I had talked enough on the phone that anyone who was serious about tracking down people who might know about his invention would find me soon enough.

But now I found myself hesitating. Destroying the headsets wouldn't solve the problem forever; if the government knew such devices were possible, some secret lab would reinvent them sooner or later.

Still, it would slow them down. Another of my old friends is in the wilderness-preservation field. She tells me that the only way she stays sane is by thinking of everything in terms of buying time. In her field, victories are only temporary because each time you save a tract of land from one threat, there's always another. But losses are forever. So you work to string together enough temporary victories that new attacks at least face an increasingly uphill battle. She and my brother wouldn't see eye-to-eye on a lot of things, but I suspect she would appreciate his concept of original sin.

Destroying the prototypes might not keep them from being reinvented, but in the interim, it would save an unknown number of people a lot of pain. Most would deserve it, but one drawback with torture is that you're never sure who's who until afterward. My friends were right. Even if the victory was only temporary, I didn't want to be the one who caused the "forever" loss.

The headsets might be prototypes, but they were solidly made and I wasn't sure how best to destroy them. I could break the moldings easily enough, but what mattered were the electronics inside, and even if I broke those, I didn't know whether a good electronics whiz could figure them out from the pieces.

Derrick had burned his, but that wasn't something I could do in my office. I stuffed them in a bag, wondering whether I could take them home and burn them in my fireplace without creating dangerous fumes. Probably a bad idea. Maybe I should just run over them a few times with my car and scatter the pieces out the window on the freeway.

I was halfway to the parking lot when my cell phone rang. I presumed it was Derrick, checking up on me, but it was a local number—and not my wife, either.

"Hello," I said, still trying to figure out who might be calling. Maybe Derrick's government types were already on my tail.

What I heard, though, was a torrent of static, kind of like the sound you get when someone forgets to lock their cell phone keyboard and it dials you at random, giving you a chance to listen to the inside of their pocket. There was a wailing sound in the background and a torrent of syllables from which I could catch only fragments: ". . . Coach . . . Highway 36 . . . cops."

"Dylan?" The transmission was so choppy I wasn't sure, but it had to be him. "Slow down. You're breaking up. Are you okay?"

If he heard me, it didn't help. ". . . blood . . . need help . . ."

Someday, someone's going to design a cell phone network that *works* when you really need it. Highway 36 put him west of town, on a two-lane that had once been a favorite drag-racing site—a bit of trivia I'd picked up from colleagues who'd been around since before rising fuel prices put the kibosh on that dangerous pastime. I thought of Dylan and his new car and shuddered.

I hung up, counted slowly to ten, and hit the callback button. Sometimes that's all it takes to get a good connection. Instead I got Dylan's voicemail, clear as a bell. I left him a quick message that he might or might not think to pick up,

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sprinted for my car, and broke a lot of traffic laws heading west.

Luckily there weren't any cops around to see me. That's because they were all out on Highway 36, about where I figured they'd be. There were also several ambulances, but their crews didn't appear to be doing much, which is either very good or very bad, depending.

Given the state of Dylan's car, the answer had to be the latter. It was upside down in the ditch, crumpled practically beyond recognition, with glass and plastic strewn along two hundred meters of roadside. A paunchy policeman tried to wave me on when I pulled to the side, but relented when I told him one of the victims had called me.

"He's over there," the policeman said, gesturing toward a space-blanket-wrapped figure talking to a notepad-wielding officer. "He's one lucky boy. Apparently he was in the backseat when the car went off the road. See if you can talk him into letting them take him to the hospital. We can get his statement later."

Dylan spotted me before I got halfway to him. "Coach!" he called, breaking away from the officer and half-running to me. He seemed eager and needy, not at all the Dylan I'd always known.

"What happened?" I asked, fighting down panic. "Are you hurt?"

"Oh, Coach, it was so awful." He embraced me—also wildly out-of-character—then with his back to everyone else, his mood shifted. "You're going to kill me when you see this." He slipped a hand into his pocket, then pressed a VR chip into my hand. "But better you than them. I tried to erase it but I didn't know how. I threw the headset somewhere off over there." He inclined his head slightly toward the roadside. "They'll probably find it, but without the chip they won't know what it is."

I looked at the chip, wondering how it related to the accident. "What happened?" I repeated.

"Andrew and Thomas are dead," he said, and fleetingly, I felt a guilty relief that I'd never heard those names before and that Dylan hadn't managed to kill off two of his teammates.

"How about you? Are you hurt?"

"I can still run," he said, and for a moment I wondered if he'd seen my relief and was too young to realize that none of us are exempt from such things. All we can do is recognize them when they occur and try to fight them off. More of my brother's original-sin doctrine, I suspected. Then I saw tears in his eyes and realized he was merely trying to cover them with macho.

"Go to the hospital," I said. "I'll take care of things here."

It was 3 A.M. by the time I finally got home. There wasn't that much to do at the accident site, but I waited for the tow truck and watched as the police cars gradually dispersed. When I had no excuse to stay, I went to the nearest convenience store, bought a coffee, and sat in the parking lot staring at Dylan's chip, nerving myself to view it. I couldn't decide whether I was glad or disappointed that I'd not had time to destroy the headsets.

At last, I put on one of the new ones, with the gain turned down far enough that whatever was on the chip wouldn't be too overpowering. The index showed seven tracks, so maybe it was merely one of Dylan's running logs and he'd simply been trying to help keep the whole project secret.

The first recording, in fact, was merely a training run, and I nearly disconnected in relief. But something told me to keep going. I skimmed the rest of the first track, sampling every few minutes, then jumped to the middle of the next one.

Even at low gain, the transition was jarring. This track had nothing do with running and everything to do with vigorous, enthusiastic sex. I immediately hit the cutoff, but still felt mentally polluted.

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At least I hadn't been Dylan. There are some things I most emphatically did *not* want to know about him.

I popped the chip out of the player and considered my options. Two cups of coffee later, I decided I really did need to know the rest—but preferably at an even lower intensity. I put the chip back in the headset and resumed scanning at the lowest level that would allow me to understand what was going on.

In track 3, I was a woman. Were these souvenirs, or porn? Most likely the latter. In track 4, I was male again, but this time I was gay. And so it went through two more permutations. I was beginning to get a hunch about where the sports car had come from. With only one headset, Dylan couldn't mass-market this stuff, but there would be people who'd pay a tidy sum for one viewing of any of these.

Then came the final track.

I was sitting in the driver's seat of Dylan's car. Beside me was a young man I didn't know, and in the rearview mirror was Dylan. The car was stationary, but then Dylan said, "Let's get this show on the road," and there was the nervous banter of college students egging themselves into action. The driver revved the engine and paused as it vibrated with power. We put it in gear, the tires squealed, and we were off. Just because it was a hybrid didn't mean it didn't have power, and whoever I was handled the curves like a pro—which was probably why Dylan had picked him to drive, rather than himself.

Still, I couldn't figure out why he had switched from porn to this. Then I recalled the one-time popularity of drag racing. This wasn't a race, but there'd definitely be people who'd pay to experience it. I thought of the missing chips and wondered how big a VR library Dylan had amassed, and how many people might have tried out the headset. So much for Derrick's big secret. Word of his VR miracle was probably on dozens of Internet chat rooms.

The car was going faster and faster. It wound through the mountains, then out onto the flats favored by the former drag racers. I/we/the-driver floored the gas and the car leapt forward, the speedometer hitting 80, 90, 100, 110, 120 . . .

Somewhere around 130 the front right tire blew. Or did it? Somehow it didn't feel right, but things were happening too fast to be sure. For one precarious moment, the car ran in a reasonably straight line, then it yawed onto the shoulder and suddenly I was flipping, sideways and end-over-end, like a running shoe in a clothes drier. An airbag inflated in my face, then burst as something, maybe a piece of the roof, was thrust through it from above. Then something else struck me, and I looked down and it was sticking out of my chest and even at low gain my world exploded in pain . . .

. . . and it was all happening so fast that it was only now that I finally found the off switch.

I sat back, shaken and terrified. What would be the result if I played it to the end? I knew what had happened to the driver. Had Dylan managed to reach him and turn off the recorder before he died? If he hadn't (and given the extent of the injuries, I doubted it), I was holding the ultimate in porn-myth: a snuff film. Not just a snuff film, but a VR experience in which *you* were the one who died.

Cautiously, I played back the first part in slow motion, concentrating on the blown tire, running through those moments again and again at increasing intensity, just as I had with Dylan's sore knee. My first impression had been correct. The tire hadn't blown. The wheel had fallen off. From the corner of my/our eye, the driver and I could see it bounding off into the ditch, although I doubt he'd had time to understand what he was seeing before we'd begun that endless series of flips.

What were the chances of a wheel coming off a new car by accident? I'd

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never driven at this speed and had no data on the risks, but it seemed unlikely.

I wondered again why Dylan had shifted from porn to this. With only the one headset, he needed recordings that could command a high price per viewing. Porn obviously fit the bill. But driving? Yeah, gas was expensive, but if you wanted to waste a gallon or two, any of those student gas-guzzlers could go as fast as you wanted. And no matter how good the VR was, the real thing had to be a bigger thrill. That meant there was a limit to how much he could charge for the recording he'd intended to make, and given the fact that he couldn't mass-produce, it didn't seem worth the effort.

Unless someone had hired him to do it. Someone who was hoping for a wreck, maybe even a snuff film. Someone who was willing to risk losing the headset in a crash because he thought he had a way to get more.

I drove back to the crash site, again courting tickets. If I was right, the people who'd set Dylan up had planned on retrieving both the headset and the chip. I wondered why they hadn't beaten the police to the crash site. Maybe they'd expected the wheel to come off in the curves and were waiting in the wrong place. Maybe they'd not counted on Dylan surviving and phoning for help. Hopefully they'd not seen him throw the headset into bushes, or they'd already have it.

The one thing I was sure of was that I wasn't dealing with feds. The more I thought about it, the fishier Derrick's visitors sounded. "Government types," he'd said, not "FBI" or "CIA" or anything else shadowy but specific. That meant he'd not gotten a good look at their IDs. Nor could I imagine real feds being so unprepared for the resistance they got from Derrick's boss. Or careless enough to be overheard talking. For that matter, I couldn't imagine them using a phrase like "humane torture." They'd say "humane interrogation" or something even more indirect, like "personal data retrieval." Most likely, Derrick's visitors had been trying to bolster their image as government agents, in an attempt to secure his headsets before the car accident.

There was also the question of what Derrick could have done to bring himself to the attention of the government, while it was obvious how Dylan's clients could have found him. The headsets bore the logo of Derrick's company, which was small enough that anyone inquiring about VR would be referred to Derrick pretty quickly.

If they knew of Derrick and Dylan, they knew of me. I wondered if I dared destroy the headsets I already had. Would they believe it, if I did?

The crash site was deserted. Until the cops took a good look at the fallen-off wheel, this was merely an accident. Still, multiple-fatality accidents are rare enough that the investigators would be back, first thing in the morning, so I had limited time to find the headset.

Wondering if I was being needlessly paranoid, I parked a mile down the road and pulled on a worn-out pair of running shoes. I couldn't avoid leaving footprints, but at least they wouldn't match the ones I'd left before. And I could throw away the shoes before going home.

Then I jogged back and began scouring the bushes for the headset. It took an hour, but eventually I found it, happy for the deserted highway, which only occasionally required me to hide from oncoming headlights.

If anyone was watching, I certainly didn't see them.

The phone pulled me awake sometime before 5 A.M. "Urrmph," said my wife, or words to that effect, followed by something vaguely like, "Saturday morning."

I let the voice mail pick it up, but thirty seconds later it was ringing again.

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Someone wanted me badly, and I wasn't going to get any more sleep until I found out who.

Grudgingly, I picked up the receiver. "Yeah?" Damned if I'd be polite at this hour.

"Hello, Coach," said a voice I'd never heard before. The tone was way too chipper for the crack of dawn, but something about it carried an undercurrent of menace. "You have something we want."

It was a line right from a bad movie, and I half-expected the next one to be "and we have something you want." But extortion is easier than kidnapping.

"What are you talking about?" I asked, trying to buy time, fearing that I might need to think fast and be unable to do so. Which was probably why they'd phoned at 5 A.M.

"Your boy calls it a VR headset," the voice said. "He says there are two of them and that by now you should have both. Plus a chip." He paused, then continued conversationally, "You know, you runner types really are wimps. A little persuasion and you cave right away. Don't worry; we merely paid him a visit. But if you want him to stay safe, bring everything to Fremont Park in one hour. Park in the main lot, and we'll find you."

"I can't get there that fast," I said, now wide-awake. "I've got the headset but it's not here." Not true, but it sounded reasonable and bought me time.

"Get it quick," the voice said. "We'll give you ninety minutes. Don't be late. It's amazing how easy it is for runners to have little, uh, accidents." He chuckled and my waking-up brain thought: *It's not me who's in the bad movie. It's these guys.* Maybe that meant that while they were dangerous, they weren't all that sophisticated.

When this was over, I'd be furious at Dylan, but at the moment, that was a luxury I couldn't afford. I toyed with calling the cops, but I couldn't imagine explaining things quickly enough to convince them to stake out the park before Dylan's thugs got nervous and disappeared.

I dressed quickly, thinking I had two advantages. One was that they saw runners as wimps, which meant they might underestimate me. The other was that they didn't know that I actually had four headsets because I'd never shown the other two to Dylan.

I had another advantage, too, which was that my wife had been a 1500-meter runner, and those folks are the toughest of the lot. She'd heard my end of the phone call and knew something was badly wrong, but when I told her I needed to think, she didn't waste time with questions. Nor were there any histrionics when I filled her in on last night's adventures and the plan that was beginning to take shape.

There was a pretty good chance I wouldn't survive it. But if I just gave the caller what he wanted, I doubted that he'd let me live. And if I refused, he'd either start kneecapping my runners or realize that the way to *really* get to me was through my daughter.

I had about an hour until I needed to be on the road. As quickly as possible, I jacked two of the headsets together and set about copying selected portions of Dylan's chip. With only one headset, Dylan hadn't been able to duplicate chips, and as long as the bad guys didn't know how many headsets I had, they wouldn't be expecting me to do it, either.

Once I had a master copy, I could make two at a time, one on each recorder. I set my wife to making as many as possible, recording them on top of old running chips that had accumulated in my study and never made their way back to the office. Meanwhile, I dashed to the corner market for a tube of Superglue.

En route, I called Dylan.

He answered on the second ring.

"I'm sorry, Coach," he began before I could speak. "All I meant to do was to show the headset to a couple of friends.

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Then we got thinking about all the cool things you could do with it. Morgan took it skydiving, and Chris used it with his girlfriend, then someone suggested it was a nice way to make a bit of money. I didn't think—"

"—that you were being really stupid." I said, wishing yet again that someone had been tougher on him, all the way back in high school. "But for now, I only want to know one thing. How many guys?"

"Two. Why?"

I ignored the question. "Describe them."

"One was tall and fat, but looked strong. The other was shorter, with a beer belly. But he was also pretty big. He was getting old—maybe your age—and was nearly bald. Why?"

Again I ignored the question. "You're sure?"

"They never mentioned anyone else. I think they were from Cheyenne. One of my friends found some folks there who'd pay $200 apiece just to view the chip, then a few days later these guys showed up and started offering $500 for special recordings."

Next, I woke up Derrick, who gave a very similar description of his "government types"—minus the bit about being "old." Derrick lives 300 miles away, which is close enough that the thugs could visit him in the afternoon and still get back here in time for Dylan's ill-fated drive, but far enough that they'd have probably sent an associate if they had one. And if they really were from Cheyenne, they were probably small-timers, because anywhere but in Wyoming, Cheyenne would be viewed as a small town.

I hoped I was right. If there were more than two, I was dead for sure.

By the time I finished with the glue, time was running out. While I'd been busy, my wife had managed to make an impressive stack of duplicate chips. Now, I handed her the original and one of the players.

"Take these, and go somewhere," I said. "Breakfast, a drive, anywhere. Make sure you have your cell phone. If you've not heard from me in"—I glanced at my watch—"two hours, take it all to the police. Then call Lauren"—our daughter—"and find a way to disappear." That way the *real* feds probably would get the headset, but there wasn't much I could do about that. If I hadn't called by that time, Dylan's clients would be well on their way to flooding the underground market with the things, and humane interrogation would be the least of everyone's worries.

At the best of times, Fremont Park isn't the type of place you go to unless you really want to get mugged. At 6:30 A.M., it was as deserted as I feared it would be. I suspected that my life expectancy could be measured in minutes.

My callers must have been watching, because a moment later a blue sedan arrived and two beefy guys climbed out. Football-player types, gone to seed. Exactly as described, but also just the type to underestimate folks like me. They were supremely confident, having done nothing to disguise their car or themselves. In their eyes, I was already dead.

"Here's what you want," I said, taking the initiative as though I were naïve enough to see this as an ordinary transaction. "But I don't know which is the chip you're after. Dylan gave me one last night but I just tossed it in a drawer with the old ones."

The bigger man stared at the handful of chips I was offering. There were eighteen of them, and I suspected these guys weren't long on patience.

"You have no idea which it is?"

I shook my head.

"Crap." He looked at his buddy. "At least there's two headsets." He opened the trunk of his car and for a bad moment I thought he was going to lock me in it. Instead, he pulled out a thick roll of gray tape.

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"Duct tape," he said, grinning wickedly. "Never leave home without it. Hands behind your back."

I nearly abandoned the plan and bolted. But the park was crisscrossed with roads and there was nowhere to go where they couldn't chase me in the car. Not to mention that even if I got away, they could still get at me through Dylan and his teammates. At least Lauren was safe.

He wrapped my wrists—tightly enough, despite the football-player mentality that underestimates us skinny types—then opened the back door of his car and shoved me in. He slammed the door, pushed a button on his key chain, and something went *snick*.

I didn't really want to get out yet, but I knew I was expected to react, so I squirmed around until I could reach the door handle with my fingers. I pulled on it, and nothing happened. I've always hated those child-safety interlocks. Now they had me trapped as effectively as the duct tape.

My captors laughed and I tried to act like a man beginning to realize he's made a big mistake. That produced another laugh, and by this time, the acting was easy because everything depended on timing and there were a lot of little variables that could get me killed. But at least they now had me sufficiently incapacitated that they would be confident about not having to keep an eye on me.

They spent a few moments studying the chips, presumably hoping to find one labeled with something more useful than a scratched-out date from its original use. Then, the bigger guy started examining one of the headsets, turning it over and over in his hands. He looked puzzled, and for a moment, I truly panicked, wondering how many times he'd seen Dylan's and if he knew something was wrong. The differences were subtle, and I was counting on him not spotting them.

As it turned out, he'd apparently not used Dylan's often at all. He turned to the bald guy and asked a question I couldn't hear, after which his companion theatrically pushed a chip into its slot and pointed to the start/stop button.

The big guy sat on a bench only a few yards from my window, put on the headset, and pushed the button. His face went slack, his eyes acquired a thousand-yard stare, and I knew he was in another world.

His companion shrugged, gave me a final glance to make sure I was behaving myself, and donned the other headset. A moment later, he too was in another world—the same one as his companion, actually, because all the chips were identical. Right now, he was Dylan, running. Normally, he'd be taking off the headset, disgusted, or clicking straight to the next track. But these were the variable-gain headsets, and I'd turned the gain controls all the way up before using the Superglue to make sure they didn't get jostled out of position. At that level, even I would have found it difficult to break the enhanced-reality's spell.

There was only about six minutes' material on each chip, but that's a long time when you're waiting for someone to die. The running was simply an introduction—something benign, because they were looking for the death scene and just might be sufficiently on guard to wrench themselves out of it, even on high gain, if it was the first thing they encountered. That was followed by several minutes of sex, just to make sure that if one was slow to put on his headset, nothing unpleasant would be happening to his friend. Then came the accident.

I have no idea what virtual death is like at high gain. Making the master recording, I'd been forced to play it at low gain, just to make sure I got the entire thing, and it had been bad enough that I'd felt my own heart lurch when the driver's gave its last beat. At higher gain, the pain and terror would be overwhelming, and everything else, I hoped, magnified beyond the body's ability to endure.

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The bigger guy was the first to encounter the accident. During the running sequence, his thousand-yard stare had never faded, but as the chip pulled him more deeply into its reality, his legs and arms began to twitch, his breathing increased, and sweat appeared on his forehead. When he reached the sex scenes, the sweat and heavy breathing increased and a thin stream of drool ran down the corner of his mouth. Pretty disgusting, especially for a non-voyeur like myself.

Then he hit the accident sequence. His whole body tensed, as though trying to brace against the car's rolls and flips. His eyes were wide. The drool turned to froth, his body began thrashing with convulsions that had not been in the recording, and the froth became flecked with red bubbles.

I waited until both men were done thrashing before trying to figure out how to get out of my prison. Then I tried to wriggle over the front seat, but the headrests were too high. Remembering how often vandals break car door windows, however, I braced myself as best I could, got my back and glutes into it, and kick-shoved for all I was worth. It was tougher than I expected, but the window wasn't all that tightly rolled up, and at the cost of bruised heels, my third attempt produced a gratifying shatter of glass.

With my hands behind my back, getting out the window without landing on my head would still have been a difficult trick, but luckily, I didn't need to try. Now that the glass was gone, I could roll onto my back, stick my head and shoulders out the window, and use the extra maneuvering room to contort myself enough to get my hands below my ankles and then, blessedly, out from behind me. Now it was easy to slither out the window, and moments later I was in the street, ripping the duct tape off with my teeth.

The two extortionists lay where their final spasms had thrown them. They looked dead, but it was hard not to believe they were simply awaiting the opportunity to spring to their feet and pummel me.

With some trepidation, I checked both for pulse. I even pinched the bald guy's nostrils and counted to a hundred, waiting to see if he'd breathe through his mouth. He didn't, and if that's not dead, I don't know what is.

I *should* have felt at least a touch of remorse. If they'd been alive, I could have bound them with duct tape and called the police. But what I felt was relief. Explaining to the police wasn't something I wanted to do.

Chips were scattered across the parking lot, which was still miraculously deserted. Feeling that I was stretching my luck, I collected them and the headsets, climbed into my car, and drove away.

That's when the enormity of what I'd done finally began to soak in. Derrick had been afraid his wondrous invention would be used for torture. Dylan had discovered porn and cheap thrills. But I'd done them one better: I'd turned it into a weapon. Not just a weapon, but an assassin's tool, with which I'd carefully laid a trap and executed two men.

Once I was safely out of the park, I pulled my cell phone from the glove box, where I'd stashed it for safekeeping, and phoned my wife. Then I crushed the headsets with the car and threw the pieces down sewers in three parts of town.

I'd always seen myself as a nice guy—a pacifist at heart. Now, I knew otherwise. True, I'd seen no alternative, but I'd been just as cold-blooded and ruthless as Dylan's extortionists. When it comes to that anti-miracle stuff, it really is true. None of us is immune.

I had to buy a hammer to crush the chips. Smashing them should have felt satisfying, but it didn't. The chips were just a symbol. What I really wanted to smash was something internal, human, and more universal than I'd ever wanted to believe. ■

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Preemption

Charlie Rosenkranz

Intelligent beings need to plan ahead—but it can be hard to recognize all the relevant variables.

One brilliant April morning, the red-eye flight of a Boeing 757 was on its final approach to Houston International from Las Vegas when a portion of its underbelly disintegrated. The resultant shock wave and missing hull section caused it to make prepunctual contact with the Earth's unforgiving surface, just short of the runway.

Three miles south-southwest, a local who was barely finished coughing into his cell phone at his boss, feigning the flu, was driving two buddies and his dog, Spartacus, to a Monster Truck Pull Rally when his SUV was vaporized. In the front, only the radiator and items forward of it remained. In the rear, only a foot and a half section of glossy red metal and sparkling chrome survived, along with one third of the gas tank. The remaining gasoline erupted as it was blown backwards, setting fire to a barbershop and incinerating a smiling cardboard cutout of the mayor—an indisputably self-described man of the people, who was locked in a vicious bid for re-election.

Just to the north, a traveling circus—currently not in the act of traveling—lost one of its larger trailers as an eight-foot spherical section of its center magically disappeared. The two ends of the trailer were blown in opposite directions, destroying a couple of valuable midway tents, but in this instance no fires materialized.

In the center of town, a pet psychic was in the process of describing the profound sense of loss and self-loathing associated with a case of overly compulsive scratching (and preparing to collect her fee) when she and her divination vacated the Earthly plane. The eight-foot spherical zone of sublimation—where solids transformed instantly into gas—also made a casualty of the neighbor's chandelier in the apartment below. Though nearby windows were blown out, the majority of the heat and force of

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the disintegration inexplicably vanished along with the seer.

Panic erupted as hundreds of similar incidents occurred throughout the greater Houston area in rapid succession. But the panic was not limited to Houston, or to the great state of Texas, for that matter. This was also happening in every other state—and in every nation on Earth.

The men on either arm were half carrying Andrew Harrison as they flew through the tunnels. Eventually they made it to the end. Over the sound of the internal pile driver hammering blood past his ears, he heard the steel door thud into place, felt the vibration underfoot.

"You nearly pulled my arm out of its socket," he said with a scowl to the one on his left.

"I'm sorry, Mr. President. I'll be more careful next time."

"Next time? Write yourself a directive: there will never be a next time." He looked around. The bunker was spacious but nonetheless felt cramped, as if he had just been banished to a hovel in someone's back yard next to their garage. Never had accommodations costing so many taxpayers so much felt so subhuman, so second-class. He marched over to another Secret Service man, this one seated at the conference table in front of a computer, pecking at the keyboard with his right hand while talking into his left sleeve.

"What the hell's going on?"

"We don't know, Mr. President. Some type of high tech assault. Explosions or disintegrations or . . . we don't know what they are, but they're happening all across the country."

"What are you talking about, 'all across the country?'"

"Everywhere, sir. Thousands of them. So many we can't even count. Reports coming in from every city in the U.S."

"My God." His knees, like a pair of garden hoses with their water source cut off, were useless. He slumped into a chair. In the last few minutes of chaos he had only been told of unexplained explosions in D.C., including one on the sidewalk in front of the White House.

"Who's doing it?"

"We don't have a clue, sir."

"Get Swick down here immediately. And locate the directors of the CIA and FBI." He switched seats and grabbed a phone. "This is Harrison. Get me McNab. Now."

The Secretary of Defense came on the line. "Andy, are you okay?"

"What's going on?" he demanded, ignoring pleasantries. "Who's attacking us?"

The first reply he received was silence.

The second reply he received was, "We have absolutely no idea."

"What? Is that the best you can do?"

"Andy, look. We've got several thousand people on this. And people from every other agency that might be of any help. So far . . . zip. People and buildings everywhere are being destroyed, and there's not the slightest sign as to how or why."

"Unacceptable. I want answers. Who has the capability to do something like this?"

Again, silence.

"No one. This is far in advance of anything we ever thought possible."

Harrison's hands felt cold even as his neck grew hotter. He felt the impulse growing to insult his long-term friend—to start yelling to relieve the pain choking his thoughts. But he didn't get the chance.

"Wait a minute, Andy. We're getting some data. Hold on."

When Secretary of Defense McNab came back on the line, his voice was shaky. "Mr. President," he began. Formal. That wasn't good. "NASA and Air Defense both confirm the appearance of a number of unidentified objects encircling the Earth."

Realizing the incomprehensible must

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now somehow be comprehended, Harrison slumped forward, a frozen image of pure helplessness. The facts trickled in: Estimated altitude of enemy vessels, 800 miles; seventeen located so far; out of range for retaliatory action; destruction occurring with spherical areas being vaporized; diameters of kill zones estimated from eight to fifty feet; similar reports from other nations; methodology unknown; attacks already suspected to be in the hundreds of thousands, possibly millions; no pattern or reasoning evident; cites, towns, and communities everywhere in chaos.

The phone seemed to increase in mass, becoming a burden to hold. His strength had been sucked away along with his ability to think. His impulse never to give in, never to back down from a fight, was annihilated. Through a numb stupor, he envisioned the end of his own life, the end of his family, and that of humanity. His Defense Secretary, dismayed and helpless, asked if he had any suggestions—again not what he wanted to hear.

He said nothing. All he could do was wonder how to say, "We surrender," in whatever alien tongue the attackers spoke, if indeed they spoke any language at all.

The FBI Director had been injured; she had been hit with flying glass from an attack. The CIA Director, having called in sick, thereby extending his vacation at his second home in Easton, Maryland, across the Chesapeake, had not been heard from since the attacks began. Two CIA analysts, Kimmells and Blix, were poring over reports on their laptops, directing occasional nervous glances toward the president. He eyed them suspiciously. They should be trustworthy: they were career analysts, but he was paranoid at the moment. The people around him weren't giving him answers, and giving him answers was the primary job of the people around him. They should all know this by now.

Additionally, emergency talks with other world leaders had been as helpful as a chat with an IRS telephone information center. The Russians, the Chinese, and various NATO leaders could do little but confirm they were enduring the same fate. They all agreed to stand firm against the aggression, not give an inch. Useless posturing.

He looked to his right. "I've got to get on the air and say something. Something to calm and reassure them. They expect leadership, deserve it, demand it. If we survive this, if we don't all get fried, they'll just turn around and roast me at the polls next November."

His ashen speechwriter nodded and gazed at an empty note pad. Three TV screens high on the wall gave flickering images—endless reports of major amounts of minor destruction on all continents. On one station, the citizenry was being interviewed. One woman said, "It's like, way totally unfair. We didn't do anything to anybody and they're totally bombing us. Are we supposed to like . . . hide or something? I'd be way pissed off if I weren't so totally freaked. What do I do now?"

Others being interviewed were equally confused and unenlightened.

"It just doesn't make any sense, sir," came a voice from across the table. Bernard Swick, National Security Advisor, was visibly shaken. His chin quivered; his jowls wagged. "Their technology is so far advanced we can't even remotely determine how it works and don't have the slightest clue as to what it is. There's no detectable beam or energy transmission. They could easily have wiped us out by now. But the attacks are completely random. Not on our key infrastructure, defense, or high technology. Mostly civilian. Totally chaotic. There's no logic to it at all."

"Unless they want to create terror before eliminating us. Unless they have some other motivation. Unless. Unless. You and the Secretary of Defense need to determine what they're doing and

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how they're doing it. Immediately. Find any weakness to exploit. Whatever their plan is, I expect you to stop it. Understood?"

"Yes sir." Swick got up to leave, at which point the Secret Service refused to open the blast door until the president turned around and barked at them to let him out.

Harrison grasped at a frenzied dust devil of random thoughts, trying to hold each of them still where he could look at them. At least his wife, Brittany, and the two kids were safe. At least for now. They were in another bunker—an Uncle Sam cave with all the amenities. But what did the supposed illogic behind these attacks mean? What did any of it mean?

He went over and sat across from the CIA analysts. "What patterns are there to the attacks? There's got to be something."

Kimmells pursed his lips, thinking about this, as if there were time for idle pondering. "Well, Mr. President, I can't say there's a pattern to whom they're attacking, but we have been able to deduce a couple things."

"Which may be mostly irrelevant," said Blix.

"Yes, but not entirely irrelevant," said Kimmells.

"That's true," said Blix.

Kimmells looked to his left. "Stop interrupting. You're distracting me."

Blix clamped his mouth shut and stared defiantly at the wall.

"You see, Mr. President, most of the attacks have been on the surface. Houses, cars, parks, apartment buildings. The zone of annihilation is always spherical. And normally eight feet or so in diameter."

"But not always," said Blix.

Kimmells shot him a look. Blix returned to his computer.

"Some of these spherical zones are larger. A few. But below ground they're *all* larger. All reports of attacks on basements, root cellars, and the like have had kill zones of twenty feet or more. And *depth* seems to be significant. For example, there was an attack on an office building over on K Street, one level below ground, twenty feet in diameter. A few minutes later, on the other side of that same building, an attack two levels down, *twenty-eight* feet in diameter. Sad, actually: it was a policeman and his dog, highly decorated, and he was investigating—"

"The policeman, not the dog," Blix interrupted..

"What?" Kimmells spun around.

"The policeman was the decorated party. Just clarifying. The way you structured that sentence, it sounded like—"

"Of course, the policeman! Blix, you're not helping!" Kimmells turned back to Harrison. "My point, Mr. President, should I be permitted to *finish* it: the farther below ground the room is, the bigger the sphere." He took a deep breath. "It could mean they're testing their weaponry in some fashion."

"But we think that unlikely," said Blix.

"That's right. Unlikely. They could have tested it anywhere. Not here and now when they're in the process of attacking us. Now it could mean their weaponry requires more power to be activated when surrounded in five out of six directions by soil and rock—"

"But we think that unlikely also," said Blix.

Kimmells sighed. "Yes. Unlikely also."

Harrison leaned forward, his temper long since missing in action, his patience on a short leash. "Get to the point. What's the most likely conclusion?"

"Well, it could well mean their detection and/or targeting technology utilizes data gathered multi-directionally—in three dimensions—and therefore is less effective below ground."

"I don't understand. Why would that result in larger explosions?"

Kimmells held up his index fingers and stared at the space between them as if the answer resided in, and could be di-

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vined from, that exact location. "Well, if they're having difficulty obtaining a bio-sign reading, or getting an exact lock on the individual's location, they could simply boost their power output and destroy a larger area . . . theoretically."

Difficulty obtaining a bio-sign reading. Growing slightly hopeful, Harrison said, almost whispered, "Any reports of attacks this deep?"

"Oh, no sir. Not even close."

Harrison felt his shoulders relax and experienced a rush of hope. Only then did he become aware of the ignoble fact that most of his tension had been tied into concern for his own survival, not that of his fellow Americans. Partially cognizant that this might be something he would have felt guilty about in years past, he nonetheless managed not to let it derail his feeling of relief.

Blix chuckled. "But statistically speaking, Mr. President, that doesn't mean very much. After all, very few people work at this depth. So, if attacks are random, based on probability it might take quite a while—"

"Yes. I get your point." So much for relief. He looked at Kimmells. "Is there any pattern to the attacks? Anything at all?"

"Well, Mr. President, there's so much chaos, it's hard to tell. And there's so much raw data, it's a gargantuan task for headquarters to sort it all. We're being sent any relevant information as fast as they compile it. The targets have been homes, offices, veterinary clinics, beauty salons, police stations, airplanes, municipal parks, duck blinds, urban, rural . . . you name it."

Harrison looked down, but held up his right index finger to indicate he had heard enough for the moment. An image of a duck blind flitted nervously through his mind, frantically searching for a place to settle down and make sense, on a quest for meaning where it could fit properly into a greater whole. It failed.

"Okay. What about the size of the . . . kill zone. You said some were larger."

Kimmells smiled, a slightly goofy and sheepish grin. "Well, the largest one reported so far was, uncharacteristically, above ground and was on what Blix and I are calling the 'busload of blind bigots.'"

"You're joking." Harrison stared at the pair of analysts, wondering who hired them. He also wondered how he had gotten stuck with these two, of all people, in the middle of this crisis. "A busload of blind bigots," he said incredulously.

"Yes sir," said Kimmells. "It seems there was a charter bus full of blind members of the KKK on their way to an annual party in Biloxi, Mississippi. They go there each year for Easter, to gamble away the holiday. The attack took out the driver, the passengers, the entire bus, and a healthy chunk of Interstate 10. We estimate a diameter of 60 feet. And a whole mess of other cars behind them drove right into the crater."

Harrison rubbed his eyes. Despite himself, he wondered how blind people gambled. Then he wondered—if they were both KKK and blind—how they would know they hadn't put their hoods on backwards. Shaking his head, he wondered if present company was possibly getting to him.

He confronted Blix accusatively. "What's taking so long with my order to attempt communication with the aliens?"

"Well, sir, they're working on it, but we're a bit short-handed. Some people went home to their families as soon as the chaos began. And some of our guys overslept. A big Caribbean theme-party last night. I wasn't invited, but . . . Wait." Looking at his computer screen, he grinned. "What do you know? They've just informed me they're ready! Just when you need something, if you try, sometimes, well, you get what you need. I was just telling Kimmells here—"

"Shut up and prepare to send my message." Harrison forced himself to concentrate on the issue at hand. He

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thought of all the exhortations of foreign leaders—to stand firm, to talk tough with the aliens, threaten massive retaliation. A big bluff. He thought of all the people dying with every minute that passed and all the additional people that would die while he pretended he could fight them—a nameless them, likely as advanced over us as we are over our cave dwelling ancestors. He wondered what kind of a leader he would be if he didn't at least try to stand up to them. He thought of the cheering crowds at his campaign stops, the friendly, innocent faces.

"Tell them we surrender. Tell them we will cooperate with them in any way they require if they will stop the attacks."

The message was relayed along a circuitous path to conceal the whereabouts of the president, then sent skyward on multiple frequencies. They waited.

Harrison repeatedly walked the length of the conference table, trying to shrug off a suffocating aura of guilt at his impotence and concentrate on a solution. He stopped pacing and turned to face Kimmells.

"Where aren't they attacking?"

"Sir?'

"Where aren't they attacking? You told me what types of places they are attacking. What types of places aren't they attacking?"

"Well, sir . . . I—"

"Movie theaters," said Blix. "Not one report of an attack on any theaters."

"Well, come to think of it, Mr. President," said Kimmells, "we don't know of any attacks on grocery stores yet."

"Or hospitals," said Blix. "Except for one. We did get one report just in the last few minutes of an attack on a hospital basement. Three levels down. Forty foot diameter. Took out everyone hiding there. And a chunk of the morgue. But that's the only one so far."

"Are people dying in every attack?"

"Not at all," said Kimmells. "Many houses have been hit when the owners were out."

"Possibly at the theater," said Blix.

Kimmells glared at his associate, looked back at the president, took a deep breath, and said, "Anyway . . . no. One report from a man says an attack took out several of his prize sheep. And his best sheepdog. And we have reports from park rangers in the Angeles National Forest, north of LA, of blasts out in the woods, in completely unpopulated areas. And from forest rangers elsewhere as well. And then, well, there was what could only be described as an odd one—"

"We're receiving an answer!" Blix shouted. "They've sent back a message. It's coming through now."

Harrison quickly slid over the conference table and landed on the floor next to Blix. On the screen was their reply: WE DO NOT REQUEST YOUR SURRENDER. WE DO NOT REQUIRE YOUR COOPERATION.

Harrison stared at the screen with a stiffness that mirrored his catatonic wits. That was their reply?

After a moment, he said, "Send this message. 'Then why, in the name of humanity, are you attacking us?'" He collapsed into the chair.

"This next response should be quicker," said Blix. Weary and frustrated, Harrison raised his head and stared at him. "Well, sir, they had to learn how to respond. Maybe even learn our language. And look, they answered intelligibly and with proper grammar."

He then returned to his computer, his enthusiastic countenance withered by the president's glare.

Blix was right. Soon the answer came: WE ARE NOT ATTACKING YOU.

Seething with anger, Harrison said, "What the hell are they trying to pull? Okay. Send this: 'You have attacked us around our entire world. Stop immediately. We will not sit idly by as you exterminate us.'" He gazed at the ceiling. "As if we could stop them," he muttered.

He went to the other end of the con-

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ference table and argued with his speechwriter, whose note pad was suspiciously devoid of anything resembling a speech. Kimmells and Blix took the opportunity to bicker with each other, after which they returned to their research, but not before Blix accused Kimmells of possessing neither the insight nor the courage that Mulder would show in a similar situation.

Soon Harrison was called back over. The response had arrived: WE ARE NOT ATTACKING YOU. WE ARE NOT EXTERMINATING YOUR SPECIES.

Blix raised an eyebrow at Kimmells, who bristled at Blix like the more irritable half of a long-married couple. "So?"

Blix then raised both eyebrows. Kimmells's eyes flared. "I don't want to hear it!"

Harrison—whose whirlwind of thoughts had lost its speed but had disrespectfully dumped the clutter of ideas on him in a heap—ignored their bickering. "This is insane! What are they doing? How do we stop it? Okay. Send this: 'If you are not attacking us, what the hell are you doing?' Yes, that's exactly how I want you to say it. 'If you are not attacking us, what the hell are you doing and why?' Send it now."

He looked at Kimmells in despair. "Does it appear they're trying to deceive us with these answers? Or could it be . . . we think so differently that they don't understand us . . . or we don't understand them?"

"Any of those possibilities could exist," said Kimmells.

Blix looked away, clearing his throat.

Kimmells continued. "They seem to be responding only to the direct communications you give them. So we get terse answers. But this time you asked what they were doing and why. Perhaps that will elicit a more detailed response. But it's also possible they misunderstand our communication somehow."

"Or not," said Blix.

Kimmells sighed abruptly, nervously. "Mr. President, there is one theory developing, and Blix thinks it probable. You see, based on some of the attacks and now this reply by the aliens that they are not exterminating our *species* . . . well, sir . . . there's the . . . the possibility that they're actually attacking our . . . well, sir, there's the possibility they're actually attacking our *pets*. . . . Sir."

Harrison coughed uncontrollably for a few seconds, silently vowing that if his CIA Director proved to be still alive, he would strangle him at the first opportunity.

"You're joking. Or you're insane."

Blix eagerly turned to face him. "To be more specific, Mr. President, I believe they're attacking our dogs." He looked at Harrison with a wide-eyed innocence that made him appear even more ridiculous. "It was hard to filter this out at first with all the confusion, but it's possible that dogs have been the target of all attacks. Human deaths are likely just collateral damage. Or sheep deaths, for that matter," he said with a chuckle.

Stunned now more than angry, Harrison tried to process the information. Okay, so there was a dog that a man lost along with his sheep. There was that policeman and his dog. Parks are often filled with people walking their dogs. Families trying to hide would go into their basements or public shelters with their . . . Veterinary offices filled with . . . Okay. Okay. But this did not in any way constitute proof. As he was about to say so, the image of the duck blind flapped its way back into his consciousness, exhausted from its migration and still searching for a place to rest. This time it was complete with two hunters and an English Setter. No. How in the name of cross-eyed, crack-smoking Uncle Sam was he supposed to believe something like this?

"What about the airplanes?" he blurted out.

"The airplanes were all destroyed from blasts to the cargo area," said Blix. "Where the dogs are carried. Also,

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we've recently had two reports of people cut in half by the spherical blast zones while walking their dogs: either poor targeting or the humans weren't the target to begin with. And lots of houses attacked when the owners were out. It was your question about where they *weren't* attacking that got me going. Movie theaters. When's the last time you saw a dog in a movie theater?'

Far from ready to embrace either the premise or its messenger, Harrison ignored the question. "What about the blasts in the woods?" He found himself compulsively making a fist on the surface of the table.

"Coyotes, I suppose. Or wolves. All the same species, you know."

"They are not," said Kimmells.

"Are too," said Blix, through gritted teeth.

"Well, what about those . . . that KKK bus?"

"Blind, sir. Guide dogs. A whole pack of Klan guide dogs, I presume."

As much as Harrison wanted to believe a scenario that didn't end with the destruction of humanity, he still was not about to take this person's idea seriously. And he tightened his fist a little more. "Have you always been prone to wild and crazy delusions?"

"No, Mr. President. Not at all. . . . Well, actually . . . Oh, look! They've responded!"

As motionless as granite, three Grand Tetons in a bunker, they stared at the screen as the message came in. It said: AT THE REQUEST OF A SPECIES THAT WE HAVE ENTERED INTO A MUTUALLY BENEFICIAL ARRANGEMENT WITH, WE ARE ELIMINATING A THREAT TO THE FUTURE BALANCE OF POWER IN THIS PART OF THE GALAXY. YOUR SPECIES, NOT REPRESENTING A THREAT, IS NOT BEING EXTERMINATED. PREDICTIONS INDICATE THAT YOUR SPECIES WILL NOT EXPAND BEYOND THIS STAR SYSTEM, DUE TO ITS SELF-DESTRUCTIVE NATURE. FURTHERMORE, WE ARE BOUND BY INTERSTELLAR CODES THAT FORBID THE TOTAL ELIMINATION OF ANY SPECIES THAT HAS ALREADY ACHIEVED FULL SENTIENCE.

OUR CONTRACTED TASK IS THE COMPLETE ELIMINATION OF YOUR CANINE SPECIES. PREDICTIONS INDICATE THAT, IF UNCHECKED, THEY WILL ACHIEVE FULL SENTIENCE AND INTELLIGENCE IN 178,000 OF YOUR YEARS—SOONER IF ASSISTED BY HUMANS. PREDICTIONS ALSO INDICATE THEY WOULD THEN RAPIDLY SPREAD THROUGHOUT THE GALAXY AND DESTROY THE PLANS OF THOSE WE REPRESENT.

Harrison felt an unannounced and unwelcome creaking in the fuzzier recesses of his harried mind and stared at Blix suspiciously. No. No, not even this loon would jeopardize his job by writing a fake response as some type of perverse joke. It had to be the real thing.

He shook his head. "Contracted assassins. Mercenaries. Sent across interstellar space in a preemptive attack to kill our dogs? Preposterous. I can't address the nation with a story like this and then find out it's wrong. It will be tough enough to do even if I'm certain it's true. How can we be sure they aren't still interested in wiping us out?"

Blix was frowning, staring at his computer screen, and didn't seem to hear the question, but Kimmells answered readily. "Well, sir, one thing that's puzzled us from the start is the lack of damage. It's—"

"*Lack* of damage?"

"Yes, sir. What I mean is the low amount of damage with each individual incineration, not the total number of attacks. You see, obliterating that much solid matter instantly should cause tremendous heat and an enormous shock wave. But most of the heat and force is being dissipated, somehow. It's as if they're actually trying to protect us. Sir."

"And the planet," said Blix, while still puzzling over the alien message. "Otherwise, 200 million of such energy releases would almost certainly devastate the Earth."

"200 million?" Harrison asked with a shudder.

"Yes. The number of dogs on Earth. But that's a very rough guess. It's likely more. I could—"

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Harrison jumped from his chair. The latest bizarre parade of facts steamrolling its way through his mind had just coalesced into bleak understanding. He ran to his speechwriter. "No time to prepare a speech. Just give me notes. I need to be on the air in two minutes. I need to warn everyone to stay away from their dogs!"

Staring at his president with an expression customarily reserved for a lunatic sporting a weapon, his mouth stayed open, unmoving. There was a tremor in the eyes as he tried to keep them focused on his boss. But after Harrison sat down and explained the situation he relaxed (somewhat) and they quickly started working out what to say.

"I understand some dog owners can be a bit fanatic," Harrison said. "Do you think they'll all listen to me? Or will some refuse, hugging their dogs into oblivion in some sort of defiant act of devotion and self-sacrifice?"

"I really wouldn't know, Mr. President. I'm a cat person."

"Yeah. Me too," Harrison said, contemplating whether it had been a mistake not to get a dog within the last couple years. Suddenly a new worry descended upon him.

He scurried back to Kimmells and Blix. "We need to at least attempt to change their minds. We can't just let them destroy our dogs while we sit and do nothing." No longer worried about the destruction of humanity (or his own survival), he was now fighting back irrepressible and prophetic images of enraged dog ex-owners marching on the White House for the next eighteen months.

Blix jumped up. "I'm so glad you said that, Mr. President! There's no way dogs can achieve sapience in a mere 178,000 years. They're just, well—no disrespect intended—they're just not that smart."

They sent a formal protest: there had to be an error—dogs could not possibly develop such highly evolved intelligence so fast.

This gave Harrison the opportunity, in his speech to the nation, to pronounce that he was personally attempting everything humanly possible to stop the alien assault diplomatically, as we had no chance of stopping them militarily.

But the bulk of his speech was simply an appeal to get everyone to put immediate distance between themselves and their dogs. Due to the urgency of the situation, he had not even spoken with other world leaders yet. Lives had to be saved, and his first responsibility was to the citizens of the United States.

That was a good touch, he thought. Of course, his subordinates were communicating with every government in the world, but that was a small detail better left out at a time when he would need all the political capital he could get.

He poured empathy into his speech. He knew their pain, but this was the only way. He felt the intense sorrow and depth of their sacrifice, but every dog owner must act immediately to protect their lives and the lives of their children. Like a mighty redwood that has had the core of its trunk hollowed out by cruel forces of nature, yet still lives, we must do our duty; we as a nation must soldier on.

No sooner had he finished his speech than a message came back from the aliens: WE HAVE MADE NO ERROR IN PREDICTION. THE TIME INTERVAL STATED IS ACCURATE.

After deliberating, they sent a new message—one designed to give a response of more than thirteen words: "Our data on evolutionary development, canine brain capacity, and intelligence levels suggest it would take more than ten times as long as you state for dogs to evolve as you claim. How do you account for such rapid development?"

Soon the answer came: YOUR PRIMITIVE EVOLUTIONARY THEORIES AND ASSUMPTIONS ARE INACCURATE. THE MANIFEST CAPACITY OF A SPECIES TO LEARN IS NOT AS IMPORTANT A FACTOR IN LONG-TERM DEVELOPMENT AS A WILLINGNESS TO LEARN. NO OTHER SPECIES ON YOUR

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PLANET EXHIBITS AS MUCH EAGERNESS TO LEARN AS YOUR CANINE SPECIES DOES. THIS SHOULD BE EVIDENT TO YOU BASED ON THEIR ENTHUSIASM FOR DOING TRICKS, STUNTS, OR OTHER TASKS, NO MATTER HOW CONDESCENDING OR ANNOYING. IT IS THIS CAPACITY, ALONG WITH ALARMINGLY PROLIFIC BREEDING, THAT WOULD HAVE SWIFTLY PROPELLED THEM TO FULL SENTIENCE AND DOMINATION OF THIS ARM OF THE GALAXY.

That would have swiftly propelled them. . . . Harrison contemplated the bleak finality of those words. He wrestled with what to do, even as he puzzled over how they knew so much about us. TV, no doubt. TV signals blabbing about us every day, heading omni-directionally into space. The same TV he repeatedly told his wife and nanny to keep the kids from watching. His kids, who were so proficient at avoiding their schoolwork. His offspring, his progeny, who apparently represented no threat to the cosmos.

Over the next several days, he tried in vain to persuade them to cease. They refused. He tried to get a delay, time to negotiate or come up with other options. They again refused; time was of the essence in their contract with the species they represented. In short order, all dogs were eliminated from the surface of the Earth, along with wolves, jackals, and coyotes. Then, as promptly as the aliens came, they left.

The devastation and terror created by the attack caused a worldwide economic slump. It was sharp and severe, though not as great as some in decades past. But this one felt deeper. The emotional loss, many would even say the spiritual loss, was unmitigated. The planet had been violated.

There was vitriolic anger toward the nameless aliens, who came to be known as the Butchers. Those who mourned the loss of their companions could not strike back at them and were even cheated out of the opportunity to have a physical image to curse, a face to hate.

Numerous incidents of unprovoked attacks on cat owners and an increase in wars around the globe seemed to prove the Butchers' claims about our species. Mankind did indeed know how to be self-destructive.

In the U.S., which had been particularly hard hit, the human population gave its best shot at returning to normal. They sought out ways to carry on.

After statues, monuments, and other shrines had been lovingly erected in memory of their pets, people turned to other sources of companionship. They adopted turtles, hamsters, parrots, and pigs. Many prior dog owners got cats—and were forced to make the necessary adjustments. Others took in raccoons, ferrets, otters, and even skunks . . . after prudent alterations had been made. They even did it despite laws to the contrary. And laws were changed. Rapidly. The times cried out for change (as much as any increment of time could possibly be expected to cry out for anything), and even old politicians can learn new tricks when forced to do so.

By the time the Earth pirouetted its way around the Sun again to the spot in its orbit we call Easter, the intense demand for rabbits was overwhelming. But, as fortune would have it, the rabbits complied enthusiastically. Rabbits always do.

Many former dog owners, with ceaseless devotion, endeavored to teach their new cats any number of tricks. The cats proved to be wholly uncooperative, some even disdainful.

Others had better luck. Crows were said to be able to learn a few words, and some would even play fetch with marbles or small rubber balls. One man from Minnesota trained his parrot to sing the Star-Spangled Banner. In defense of his bird and its rendition, he said, "Well, he ain't perfect, but he sure is better than some people I've heard sing it."

No one could argue with that.

Otters, it was found, would hang their heads out of moving car windows just like dogs, and—as a bonus—they could

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learn a wide array of tricks. Being the providential creatures that they were, they became popular overnight.

Pigs could be taught to wake their owners (albeit with a limited degree of finesse) at just the right time of the morning, and altered skunks were discovered to be amazingly affectionate. They also had the side benefit of scaring off burglars and pesky door-to-door salesmen.

But parrots would not fetch the morning paper, and pigs were sadly lost when it came to the finer points of how to retrieve a stick. Cats could not be trained to bark in an attempt to frighten the mailman, and skunks would not bring slippers to their owners. Despite mankind's best efforts, life was not the same.

Very few people blamed President Harrison for the disaster, and he received high marks for many eloquent, consoling speeches. But when November rolled around, they voted him out of office in one of the most crushing landslides in modern American history.

He was trounced by the junior senator from Missouri, a father of four, who had been the proud owner of a Malamute and two Dachshunds.

On the morning of January 16th, President Harrison descended in the elevator along with four Secret Service agents, whose protests he had overridden by coming here. But for now, he was still president, and they still worked for him.

"It's safe, guys. Relax." Carefree lately, having fully accepted his defeat, he smiled at them as they got off on the bottom floor. But they weren't much for smiling back.

It wasn't in their nature.

Major Parker, head of the local operation, greeted him. "Glad you could make it, Mr. President."

"Oh, I couldn't pass up this opportunity, Dane. It was now or never for me."

They passed through four blast doors, each one closed in their wake. Harrison contemplated the two thousand feet of rock above them. He also contemplated the brave members of the intelligence and military communities who had been lost in this campaign.

"What's the latest count?"

"1,287, sir."

"1,287? That's up quite a bit, isn't it?"

"It sure is. In fact, six more just this morning," he said proudly.

As they walked into the main hall, Harrison was surprised to find himself overcome with emotion. Nearly seven hundred dogs were neatly assembled in rows and columns in front of him.

"This room's more packed than some of my campaign rallies," he said, feigning a puzzled scratch of the head. "And a more enthusiastic crowd, too."

And they were. Tails were wagging that belonged to Irish Setters, Dalmatians, German Shepherds, and Pomeranians. From Golden Retrievers to English Sheepdogs, Labradors to Papillons, there were thirty-seven breeds represented, as well as a broad assortment of mutts.

He had been briefed prior to coming, just as he would have been for a press conference. Stay away from the Husky in the front row—you give him a little attention and he'll demand more. And the Cocker Spaniel next to him bites. Yes, exactly like the press.

"These are all local dogs, Mr. President."

"Yes, I know." Only thick lead containers with no air holes had proven safe to transport the dogs in. Other attempts had resulted in dogs and the government officials moving them being destroyed. Limited air supply had necessitated carrying sedated dogs from nearby locations only.

"And a proud lot they are," Harrison said.

"Sir, I understand we may be working out a cross-breeding program with the Russians. Any word?"

"Oh, that's for the next administration to decide. I'm out of that picture. But

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the Russians do have a sizeable population. And the Brits, too. The Brits have more than we have in Colorado."

"Really? I didn't have details. They keep me in the dark down here."

Harrison laughed. "They probably do. They do that sort of thing. Well, I'll tell you something you don't know, then. When the Egyptians were informed of the alien inability to see through solid rock, they successfully barricaded about fifty of them in a tunnel underneath one of the pyramids.

"That's fabulous, sir."

"I tell you, Major. Those Butchers may be right about us. We may not make it. We may end up destroying ourselves . . . perhaps with the same finality with which they destroyed my career. But I'll be damned if we're going to let them cheat Earth out of its rightful place in the galaxy."

A Pembroke Welsh Corgi barked in agreement.

"I have something to show you, sir. Over here." He led the president to the far side of the room, where forty-two dogs were separated into seven rows of six each. One of the trainers held up three fingers. They all stood on their hind legs and raised their right front paws, giving the president a salute.

"Ho! That's wonderful!"

"Well, Mr. President, you *are* still the Commander In Chief, after all."

"Ah, not for long. Not for long."

"Well, I can guarantee you, sir, every one of them would have voted for you if they could."

"Hah. I could have used their support. But I'm afraid that would have required a Constitutional Amendment."

He knelt in front of a Golden Retriever. "What's your name, soldier? Would you like to be given the right to vote?"

"His name is Buddy, Mr. President," his trainer said.

Buddy indicated his voting preference with his tail.

He looked into Buddy's eyes. And at that moment President Harrison understood, far too late, what a fool he had been for never having owned a dog.

The Corporal grabbed the disk and turned around. "Get the Frisbee, Buddy!" he yelled. He tossed it toward the Golden Retriever.

Buddy came to full alertness as the plastic disk sailed his way. It was headed over him, a fairly long throw. His tail wagged randomly, but his eyes followed the disk's movements exactly.

"Catch it, Buddy!"

Buddy was watching the exact angle and speed of the disk. With an eager burst of enthusiasm he ran after it, not taking his eyes off it even to blink. It was rising up on the right hand edge ever so slightly . . . it would soon change course, curve back, dip to the left. He kept running. He knew full well he would soon have to turn and run back the other way; he wasn't fooled a bit. But he enjoyed chasing it in both directions, then catching it at the earliest possible moment. That was the best way to play the game, the way that made it the most fun.

He reversed course, whipping his head up to stay on track with the disk. It was losing speed and altitude now, and he could project exactly when and where he would be able to jump and grab it. Another second went by, and he confirmed the projection. Two and three-quarter seconds after that, he jumped. This moment represented the culmination of the game, the point of success or failure.

He had timed it perfectly. His teeth bit down, and it was now his. The plastic of the disk tasted like triumph.

"Great catch, Buddy!"

He trotted proudly toward his owner. He liked this new owner who gave him these games to learn. At first, this person had smelled like a stranger. Soon thereafter he smelled like an acquaintance, maybe even a neighbor. But now he smelled like an *owner*, and Buddy loved that. It filled him with a sense of

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belonging and security.

He surrendered his prize and then started to trot back to his position, to practice the game once more. He even was beginning to like this new home—these big, square caves with doors and smooth walls and ceilings. But he missed going to the park: the old place with the soft grass that smelled like nature, the fresh breezes that smelled like exhilaration, and the brilliant sky overhead that shone like freedom.

The man prepared to throw the disk again, and, in less than the brief flicker of a dog's heartbeat, faster than the wag of a joyous tail, Buddy forgot all about the park. Because the game was ready to begin anew. He loved all these amazing games: this flying disk, the balls, the stick, and many more. He even liked the new ones where he held up a paw or spoke when his owner showed him a particular object or held up the same object two times in a row. Those games were harder, but he vowed to keep learning them.

The man threw the disk again, and he studied it to see precisely how it would behave this time. He would keep analyzing this game until he mastered it. Just like the other games, he would learn them all. The disk soared overhead, and once again exhilaration ruled the universe. He bounded after it. It was leaning differently this time . . . this disk was delightfully, deviously tricky. But no matter what, he would keep working at it until he was flawless. At every opportunity, with every breath, he would keep striving, he would keep learning. His reasoning for this was as resolute as it was straightforward.

It's what life is all about. ■

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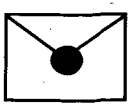

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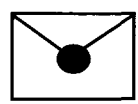

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THE ALTERNATE VIEW Jeffery D. Kooistra

MY MYSTERIOUS FATHER

It is not unusual for *Analog* to feature a seasonally-flavored story or article appropriate to the date on the cover (even though said issue might hit the stands a month or two before that cover date). Hence, the July/August issue might feature something suitable for Independence Day. The October issue almost always has a story appropriate for Halloween. I myself once wrote a story for Christmas ("Easter Egg Hunt: A Christmas Story") that appeared in the December issue of 1997. But I can't remember *Analog* specifically including a piece for Father's Day in the June issue, though no doubt some such pieces have appeared through the years even if only by coincidence.

I'm going to write one this time because, though my dad died in 1989, these past few months I've been walking down a path he once walked, literally following him step by step. There is a nostalgia factor involved too, what with writing this between Thanksgiving and Christmas. And something about Dad has long mystified me, but I think I've finally figured it out.

I'll get to the mystery, but first let me tell you about my dad.

Franklin Kooistra (he had no middle name), born in 1924, came to the U.S. at the age of four, just in time for the onset of the Great Depression. His parents and his four brothers and five sisters (he was the youngest) settled in Grand Rapids, Michigan, which was already home to more Hollanders than almost anywhere else in the United States.

Like many boys of that era, he grew up poor but didn't know it. He went to school through the 8th grade and then, this being the depths of the Depression, to work, helping the family make money any way he could.

Despite his lack of much formal education, Frank liked to read, and he was becoming quite the jack-of-all-trades by the time Pearl Harbor rolled around. The then 17-year-old lad cried when his brothers got to enlist but his father wouldn't sign for him so he could go, too. Nevertheless, once he turned 18 the following May, he signed up with the Navy and became a gunner's mate, manning the weapons on assorted merchant ships and seeing the entire planet.

After the war Dad met my mom, Trudy. He fell in love with her instantly, and on that very first date he told her he was going to marry her, which he did.

Their first few years together Frank and Trudy lived in the second floor apartment of his sister's house. This was while he was building, by himself, the house in which I would grow up. I don't know when it was Dad learned to be an architect, because he also designed the house. He also laid the blocks for the foundation alone, and did the plumbing, and the electrical work, and the septic system, and all the concrete for the driveway. Apparently, an 8th grade education went a long way in those days. The only things he had professionally done were the plastering and digging out the basement. But he'd been doing the latter by himself with a shovel when someone came along and offered to bulldoze it out for him.

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My account of Dad's abilities is reminiscent of Heinlein's descriptions of E. E. "Doc" Smith, who was the archetype of the "man who could do everything." You might think Dad's talents were inflated when I was told about things he did prior to my being born. But I *saw* him do these things, too. He finished the upstairs of our house when I was very young, but I still remember moving into my bedroom. Now that I can appreciate it, I marvel at the precision with which he cut and varnished every piece of trim. In junior high I helped mix the concrete when it came time to redo the driveway. I saw just how expert and accomplished Dad was in real time as over the course of a few summers he pieced it all together one four-by-eight-foot slab at a time. The job was quite the elaborate masterpiece sculpture when he finished, so he must have drawn a few sketches. But most of it was built straight from his head to his hands.

Another summer I helped Dad connect our house up to the city septic system. I used a hand pump to pump the water out of the long, deep, skinny trench he was digging, by hand, from the road to our house. He made portable plywood walls to keep the sides from caving in. His friends never forgot that episode. When later in life he became a maintenance man, his coworkers marveled at his knowledge, range of abilities, and general omni-competence.

Until I grew up, I didn't realize how unique my dad was. Since he really could fix anything, I didn't know most dads couldn't.

Peace did not always reign between Dad and me. We used to argue a lot, though not about the length of my hair or anything like that. We'd argue like the dickens over whether or not it would ever be possible to go faster than light. He insisted that Einstein showed it couldn't be done. Out of love for *Star Trek*, I argued that there must be a way.

And here is where the mystery shows up. How could my dad, with his 8th grade education, understand Einstein? *Hear* about or read about Einstein, sure. But Dad understood him.

Right after he married, Dad got a job as a truck driver, taking a semi all over Michigan, delivering groceries to A&P stores. Wanting more out of life, he decided to take a radio and TV repair correspondence course. This was in the early '50s. The manuals he used are very much a product of their time. The early booklets in particular talk repeatedly about how exciting the field of electronics is, how it is expanding, and how great the opportunities are for the *man* who masters it.

Dad was undaunted by his lack of a high school education. He taught himself whatever additional mathematics he needed to master the course work, since by the time I came along, he did indeed repair TVs as a side business. I fondly recall a time when our basement was full of old televisions in gorgeous cabinets, and even a couple of old console radios, taller than I was.

I remember asking him how it was he knew how to repair TV sets. Though I was still in elementary school, he gave me his old manuals and encouraged me to read them. I didn't read all of them then—there's something like a hundred of them. Yet it was then that I began to learn the wonders of electronics, albeit just in time for vacuum tubes to go out of fashion. However, the education I got from reading those books, checking out tubes on the tube checker, and building a one-tube radio receiver, was nothing short of fantastic.

Recently, I've had reason to go back and study those TV repair manuals again, and this is my father's path I've been following that I alluded to earlier. I'm not walking it because I intend to fix antique radios for a living, but because so much of the circuitry in use today was pioneered during the post-war explosion in electronics that put a TV in almost every home by 1960, and these

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manuals are so clearly written. The bulk of the electronics we find on store shelves today are not at all new in terms of the core ideas. We do things faster today, and far more cheaply, and with far greater reliability, and with far less power and tremendously greater efficiency. But the, a-hem, *analogs* of that commercial circuitry we enjoy today were right there in the TV circuits of yesterday.

To this day I feel the way to teach electrical engineering is to go back to the beginning and understand the basic physics of the early devices. The laws of nature reside very close to the surface in a vacuum tube. In the course of his studies, my father learned why heating the cathode helped to make the electrons come off, and how those negative electrons are accelerated toward a positive anode. Between the cathode and anode are several grids—depending on the tube and what it's supposed to do, there might be none, one, two, even five or more. He had to learn what those grids did, and why, and that involved physics.

As a necessary aside, back in the early '90s I ran into a young electrical engineering student (a pretty girl as a matter of fact—times have changed) who had *heard* of vacuum tubes, but confessed she couldn't recall ever having seen one (CRTs don't count). So for some of you younger readers, think of the inside of a vacuum tube as a collection of concentric metal cylinders, screens, and spirals of wire. The innermost hollow cylinder is the cathode, inside of which is a filament similar to what you'd find in a light bulb. Exterior to this is a cylindrical screen or spiral of wire—this is the control grid. Outside of that might be several more screens or wire spirals. Outermost is another cylinder, the anode, and all of these are inside an evacuated glass envelope, with pins coming out of the bottom, which is one of the few characteristics tubes have in common with integrated circuits.

Returning to the physics, consider the grid closest to the anode in a multi-grid tube. That one was called the suppressor grid and its purpose was to keep that fraction of high-speed electrons that impacted the anode and bounced off from escaping back toward the interior of the tube. So as a budding wizard of tube technology, Dad learned the physics of particle beams, and he learned it dozens of lessons before even getting to the picture tube (which is *all* particle beam physics).

And Dad couldn't have begun to do communications electronics without learning the physics of resonance, wave reflection and interference, transmission line theory, parasitic capacitance, and a host of other things. In short, factoring out the vector calculus and quantum mechanics, Dad's TV repair course amounted to about eighty percent of a college physics degree today.

How could my dad with his 8th grade education understand so much physics? That was the mystery. Elementary schools may have been good in his day, but you didn't get to Einstein there, or even in high school, not even then. It was one thing for Dad to know how to do so many of the industrial arts. During the Depression, boys could wander around unaccompanied and watch craftsmen at work. Unencumbered by fear of lawsuit, these craftsmen would show an interested lad their trade. But it is unlikely he would have run into a physics teacher scrawling equation-graffiti on the wall of a building.

But now I can picture my dad, sitting in the dark in his basement TV shop, the room illuminated solely by the glow from the tubes of a radio freed from the confines of its cabinet—like the lamps lighting Newton's study. I imagine him, in the quiet, thinking deeply about what was really going on inside those tubes, sorting out the science for himself.

Dad knew so much about physics because he was doing it every day. ■

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Assumptions are easy to make,
and hard to refine. . . .

THE DOOR THAT DOES NOT CLOSE

Carl Frederick

Illustrated by Tom Kidd

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As he walked closer, the ancient stone structure looked more like a bunker than a Roman temple. Thorvald felt a twinge of collective guilt. If the guidebook was to be believed, that squat monstrosity had been designed by a scientist like himself.

"Sure is ugly," said Roger, walking alongside.

Roger appeared to be about twelve years old. He had blue eyes, blond hair, and wore a polo shirt, shorts, and sneakers. He looked more like a stereotype than a kid. Thorvald had to remind himself yet again that the boy was not of this Earth—or indeed not of any Earth.

"Ugly it may be." Thorvald paused to swat at a mosquito. "But speaking as a physicist rather than an amateur archeologist, this building is impressive. It's survived intact for almost two millennia." He shook his head. "But I've never seen a Roman building like this. It seems ugly on purpose."

"It doesn't look big enough for many hiding places." Roger swatted at a mosquito as well—even though the insect didn't seem interested in him. "You really think the codex is inside?"

"Yes." Thorvald sighed. "I'm afraid so," he added without intending to. Roger, although he could bleed and feel, was actually an android. But the creature that controlled him through telepresence was indeed a child. And although that child was an alien, far off on a spacecraft hovering above Earth, Thorvald had grown fond of him—or it. And once the codex had been recovered, Roger's mission on Earth would end.

"You know," said Thorvald, "I've been your tutor for about six months now. I'm going to miss you."

"I'll miss you too, sir." Roger shuffled a foot. "I wish I didn't have to go."

Thorvald tousled the boy's hair. He'd done that simple act so often, he no longer felt self-conscious about it.

Roger leaned in like a cat wanting to be scratched.

Embarrassed by the show of affection, Thorvald reverted to his role as a teacher.

"Do you know where we are?" he said.

"Of course." Roger padded a few steps ahead. "Constanta, Romania."

"Ah. But the ancient Romans called it Tomis. This was an important town in the Roman province of Dacia."[2]

"Doesn't look very important, now."

Thorvald gazed around at the desolate countryside and nodded. "Dacia Felix, they called it. Happy Dacia. And the region stayed happy until the Visigoths and Carps overran it."

With Roger at his side, Thorvald trudged up to the front of the temple. He carried a flashlight and gestured with it. "The Romans simply abandoned the place. Hard to know why. Some say the evacuation of Dacia marked the start of the disintegration of the Roman Empire."

INTRAREA OPRITA, read the sign hammered into the heavy wooden door.

"'No admittance,'" said Roger, "but of course we're not expected to know Romanian. So let's go in."

"You certainly seemed to know Romanian back when we were renting the car."

Roger shrugged. "Kids learn languages easily."

"Very funny."

Roger giggled. "Okay. I've got translation software."

Thorvald wrinkled his nose—a sign that he was puzzled. "Are you saying your people have done translation software for every language on Earth?"

"No. But yours have." Roger laughed again. "It's neat having Internet access."

Roger bounded up the stone steps. Thorvald followed the boy inside.

The temple, though reasonably intact, still had sufficient gaps in the stonework that they could see their way by the sunlight pouring through the holes. Thorvald tucked the flashlight under his belt.

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The central chamber, dank and smelling of animal habitation, had the usual assortment of divine statuary scattered around the periphery. The domed ceiling, like an ancient planetarium, depicted the sky at late twilight. Time-worn blues as well as faded reds and ochres served as background to dots of white representing the visible planets and the brighter stars. A massive stone pillar stood in the center of the room. Jutting from the middle of each wall, mythical animals, each clearly representing a point of the compass, stood on smaller versions of the central pillar.

"Boy, it stinks in here," said Roger.

"Strange," said Thorvald, running his hands along the rough stonework. "The proportions are all wrong. The pillar is too massive." He walked around the fluted column. "Must be over five feet thick. And this chapel is so small, there doesn't seem to be a need for a pillar to hold up the building."

"Maybe the building is holding up the pillar."

Thorvald chuckled. "Interesting notion." He circled the pillar again, looking for cracks that might indicate a doorway. "No secret entrance, I'm afraid." He stepped back and looked up at the juncture of the pillar with the top of the temple and then down at the stone floor.

"Now this is odd." Thorvald sank to his knees. "This pillar has no stylobate, no real base; it seems to just extend down into the ground." Crawling around the column, he followed a crack in the floor that completely encircled it. He pulled a ballpoint pen from his shirt pocket and, using it as a chisel, tried to worry some of the grime out of the crack. But instead of coming out, the dirt fell deeper into the narrow fissure.

"You know, Roger, you might be right." Thorvald looked up at the boy. "I think the building *is* holding up the pillar." He got to his feet and brushed the dust from the knees of his pants.

"This is really neat," said Roger.

Thorvald smiled. "Yes, it really is." He pointed to the top of the column. "The pillar exudes a sense of permanence. But look how those lintels are pinioned. If you could rotate them, I think the pillar would slide into the ground."

"Wow!" Roger patted the massive stonework, then gazed up at the marble ornaments that jutted against the upper lip of the column. "If I stood on your shoulders, I could reach those."

"And, if you could?"

"I might be able to turn them."

"Fat chance."

"Well," said Roger. "I could try."

Thorvald nodded. "Fine." He made a stirrup from his hands and Roger used it to climb onto Thorvald's shoulders. Roger seized one of the lintels and, grunting from the effort, he twisted it. Creaking and scraping against its support, the lintel turned.

"Unbelievable," said Thorvald.

"I'm stronger than I look."

Thorvald stepped a third around the pillar's circumference, and Roger released the second lintel. At the final latch, Roger had trouble.

"What's wrong?" Thorvald gasped out the words. He bore not only Roger's weight, which was slight, but also the surprisingly intense force of the boy pushing against the ancient marble.

"It's the last one."

"Can you do it?"

Roger grunted as he threw his weight into the task. After half a minute or so, he stopped.

"No. I can't."

Thorvald helped the boy to the ground. "It was a good try." He wriggled his shoulders. "I think I'm getting too old for this kind of work."

"I could do it if I had a hammer."

"Well, we don't have one." Thorvald paused. "But there's a tire iron in the car."

"Hey, great!" Roger ran toward the door. "Come on. Let's get it."

Thorvald chuckled at the boy's enthusiasm. "I don't know. If I'm wrong about

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this, we'll have damaged an important archeological site for nothing."

Roger watched him with an expectant look—like a dog waiting for a stick to be thrown.

"Okay, okay," said Thorvald. "We'll get the tire iron."

"You know," said Thorvald, as they walked the half mile or so back to the car, "it's going to be a little lonely for me when you go home. I've always been a scientist and never bothered with family." He sighed. "I really should have married and had a family. You make me realize how important that is."

"Why don't you come with us?"

Thorvald chuckled, then patted Roger on the shoulder. "I wish it were that easy."

They walked in silence for a while, and then Roger said, "There's a colony of Earth people on my planet."

"What?" Thorvald froze in surprise for a moment, then lengthened his stride to catch up to the boy. "People from Earth? Really?"

Roger kicked at a flat stone and sent it spinning along their path. "I was taught that when my kind first visited Earth, we had a large study team. The Romans thought we were gods or something." He kicked at another rock. "Then they thought we were too immature to be gods." He kicked at yet one more stone. "They should talk; Roman gods act really silly." Roger looked up at Thorvald. "Anyway, they finally decided we were demons. Our expedition had gotten into so much trouble here that when it left, they had to take a lot of Earth people with them."

"Why?"

"Those people helped us. And if we hadn't taken them with us, they'd have been in really, really deep trouble."

"Yes." Thorvald nodded. "They probably would have been."

"My home isn't so different from Earth." Roger jumped to swing on the branch of a tree. "The Earth people are pretty happy there. In fact, there are two of them on the ship. You'll like them. They speak Latin."

"You could have told me this before."

"Yeah. I guess I should have." Roger lowered his head. He looked contrite. "After the last visit here, my people made it a rule not to interfere."

"So that's why this expedition is a secret," said Thorvald, "and only consists of one person—a kid, with an invisible ship hovering above."

"The ships of our first expedition couldn't hover." Roger dropped to the ground. "Back then, we didn't know how to stop gravitational energy from being converted to kinetic energy."

"How *do* you do that?" Thorvald hoped that finally, after months of asking, he'd learn something about the alien's science.

"I don't know," said Roger. "I'm not a physicist."

"Well, do you know how come your ship isn't visible to us?"

"No. Something to do with bending the light so light coming in on one side is moved so it comes out the other side."

Thorvald sighed. "Look, I *am* a physicist. I've got to know. Are black holes actually wormholes? Is the multi-world interpretation of quantum mechanics valid? Is general relativity correct?"

Roger balled his fists. "I told you before," he said in a quavering voice, "I'm not allowed to talk about that. Even if I knew, I couldn't tell you." Roger looked down at the ground. "I'm sorry."

"Okay, okay," said Thorvald. "It's all right."

At the car, Thorvald took the tire iron from the trunk and then he and Roger headed back.

"You know," said Thorvald, after they'd been walking for a few minutes, "I never quite understood why the codex was so important to you that you'd come all the way back to Earth to find it."

"The main purpose of the trip," said

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Roger, kicking now at some scraggly undergrowth, "is observation of your culture. But now that Earth is so advanced, we can do that just by watching your television programs. We didn't have to land."

"But you did."

"The other purpose was archeology—archeology of our culture. We wanted to see if there were any surviving artifacts from our first expedition."

Thorvald chuckled. "As an amateur archeologist, I can understand that."

"And we wanted to know if the codex was real or just a legend."

They walked in silence for a while.

"Sometimes," said Thorvald as they came in sight of the temple, "you seem considerably more mature than your appearance would suggest."

"Oh?"

At the temple, Thorvald noticed that it was not as they'd left it. A slab had fallen from the domed roof and lay, one end buried in the earth, near the entrance door.

"What happened?" Roger circled the fallen block, tracing a finger around its perimeter.

"I'm not sure. Probably with only one support point for the pillar, the center of force shifted off-axis." Thorvald darted into the temple; it seemed dark after his walk in the sunlight. "We've no choice now. We've got to free the last lintel—to take the stress off the roof." As Roger ran in behind him, Thorvald added, "But at the first sound of the building shifting, we get out fast. Understand?"

"Yes, sir."

They went to the pillar.

Thorvald handed the tire iron to Roger and then, already sweating from his hike to the car, hefted the boy to his shoulders.

Holding the iron like a baseball bat, Roger took a swing at the lintel. "The building seems okay," he said after the reverberation faded.

"I think it is." Thorvald listened and felt for vibrations in the structure. "Give it a few more whacks."

Roger complied and gradually, accompanied by the low rumble of brickwork grinding against marble, the lintel shifted to its home position. Roger leapt from Thorvald's shoulders to the ground.

A loud crack followed by a moaning sound filled the chamber. Thorvald pushed himself back against the wall. Instinctively, he put a protective arm around the boy.

The pillar slowly, very slowly, sank into the floor. As it did so, the compass figures emitted wailing tones and plumes of ancient dust puffed from their mouths.

"Wow!" said Roger.

"Pneumatics," said Thorvald. "The Romans were known for it."

The pillar receded until its upper lip became flush with the ground. The rumbling stopped and all was silent.

Thorvald listened hard. "It's okay," he said after a few moments. "I think the building's safe." He looked to the center of the temple. It seemed larger now, with no column in the middle. Glancing down, he saw that the top of the pillar outlined a disk of blackness—a hole. The pillar was hollow.

"Wow!" said Roger, rushing forward to peer into the opening

"Careful!" Thorvald approached the hole and switched on his flashlight. Directing the beam into the cylinder, he could make out a series of brass rungs—a narrow ladder built into the inner wall of the pillar. "Wow, indeed!" Then he saw an inscription chiseled in the upper lip of the column:

IANUA QUI NON CLAUDEAT

"'The Door That Does Not Close.'" Thorvald played his light over the two-inch high lettering. "I wonder what it means."

"Maybe it means that we can't raise the pillar again."

"The Romans were a solemn peo-

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ple—at least where inscriptions are concerned. I assume there's a deeper meaning." Thorvald leaned over the rim and scanned the ladder with the flashlight. "Looks sturdy enough." He stepped gingerly onto the top rung. "It's firm. Let's go down."

"This is really exciting," said Roger.

"Yes." Thorvald chuckled. "It really is."

Thorvald saw that the lower rim of the pillar rested on a lip of stone, and the hole extended farther down. A second ladder stretched another ten or so feet to the bottom. In the beam of the flashlight, he could see the hint of a vaulted passageway at the bottom.

"I'll go first," said Thorvald. "This might not be safe."

"What are you talking about?" Roger glanced down into the hole. "I'm in a telepresence vat up in my ship. I'm much more safe than you are."

"Still," said Thorvald, knowing he was being irrational, "I'll go first."

He climbed down and shined his light into the passageway. Then he called for Roger to follow.

Waiting for Roger to descend, Thorvald shivered in the chill of the cave; his sweat-soaked shirt now bathed him in a clammy coolness.

As Roger hopped from the last rung to the floor, Thorvald pressed forward into the passageway. The tunnel went straight for about fifteen feet and terminated at a chamber cut into the bedrock. The grotto was roughly square. Thorvald estimated the dimensions at about seven feet on a side and, as he had to stoop, just barely over six feet in height. Against the back wall, an unadorned shelf had been carved into the stone. On it, covered in dust, sat a rectangular leather container some seven or eight inches on a side, and about an inch and a half thick. It was secured by a thin leather thong attached to a flap.

Thorvald picked up the case and blew off the ancient dust, coughing as he breathed some of it. Carefully, he untied the thong and eased open the flap. "The leather is amazingly supple, considering its age." He pulled out a book. The pages were thick and rough—parchment made from a cured animal hide. He returned the volume to the shelf and examined its container. The leather was tooled with engravings of toga-shrouded deities, and also of something that might very well be a spaceship.

"The codex!" Roger took a few small jumps in obvious excitement. "It must be the codex."

"It must be."

Roger picked up the little book, opened it, and glanced at the text. "Gee. I didn't think I'd need *Latin* software." He passed the codex to Thorvald. "The colonists' Latin sure doesn't look anything like this."

"After eighteen hundred years, I'm not surprised." Thorvald handed Roger the container, then shined the light onto the text: late imperial dialect, but a Latin he could read. "They knew about you guys," he said. "They understood your capabilities."

Standing on tiptoes, Roger watched Thorvald pore over the text. "Could you read it to me?"

"Um," said Thorvald, engrossed in the codex.

"Please."

Thorvald nodded. "'The visitors are not gods.'" He ran a finger lightly over the parchment, translating as he went. "'They are worse than gods. They are a civilization far more advanced than Rome. We are not their equals. We can never be. No longer can we consider ourselves the masters of all peoples. And it is senseless to continue acting as if we were. This knowledge, I have sealed. But once revealed, it can never be called back. The door, once opened, cannot be closed. Because of a sense of history, I feel compelled to chronicle these events. I leave it to whomever finds this document to think well before

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revealing it. I leave it to your conscience as a Roman. Myself, I can no longer pursue science. To do so would make me feel . . .'" Thorvald looked up from the manuscript. "I'm not sure of this word. 'Ridiculous,' I think."

Thorvald rubbed a hand across his eyes. "That's the beginning of it, anyway." Carefully, he closed the ancient book. "The rest is mainly a journal." He aimed his light down the tunnel. "I think we should get out of here. I don't think the flashlight batteries are particularly fresh. And I'm getting cold."

Cradling the codex, Thorvald turned and led the way back to the ladders. "It's sad, really," he said. "When your people arrived, his belief in the inherent superiority of the Romans was crushed." Thorvald looked back over his shoulder. "Can you understand how he felt?"

"Our presence destroyed his world." Roger shook his head, and the weariness of the gesture made him seem ageless—ancient. He stroked the container's leather engravings. "We vowed never to let that happen again."

Thorvald nodded. "That must have been how the Neanderthals felt when the Cro-Magnon arrived." He glanced at the codex. "There was no turning back that knowledge. The door, once opened, could not be closed."

"Can you go back and pursue science?" asked Roger, when they'd reached the base of the ladder.

"What?" Thorvald, taken aback by the abruptness of the question, spun around.

"Can you be a physicist again?" said Roger.

"What a question. Yes. Of course, I can. Physics has been my life—*is* my life. And . . ." Thorvald paused, then looked away into the darkness. He gave a short bark of a laugh. "Who am I trying to fool?" He sighed. "You know," he said, turning to Roger, "for months now, I've been evading that question." He balled his free hand into a fist, his fingernails digging into his palm. "Yes, I'd like to learn the physics your people know. But the real joy of physics for me is the discovery. Not necessarily *my* discovery, but just being part of the community of scientists that are in the hunt."

Thorvald smiled. "This sounds like gibberish to you, doesn't it?"

"No."

"Actually," said Thorvald, "I'm not sure I could return to science now. At least not for a while, and not with the same passion. Your people know physics that I could never hope to discover. And if I did make discoveries, I'd feel as if I were just reinventing the wheel."

"I *hate* that," said Roger with vehemence. "I'm really sorry."

Even in the dim reflected light from the flashlight, Thorvald could see the deep sadness in Roger's eyes.

"Roger. It's okay."

Thorvald idly opened the codex and played the light over the pages.

"Oh," he said, both from the surprise at what he saw, and as a ploy to divert Roger from his melancholy—and perhaps to escape his own sadness as well. "There's a second section."

Concentrating more on the mechanics of translation than on meaning, Thorvald began reading:

"'Section II—The Scientific Knowledge of the . . . the Sky-dwellers.

I write not what I understand, for I understand not at all. I write what I've been told. And I write with sadness knowing that once I was a scientist, but now I am merely a scribe.

Subsection I—The Sky-dwellers' Understanding of Time.

Time is a structure that—'"

"Stop," shouted Roger. He pushed the flashlight so its beam left the page. "Don't read it! Please, don't read it."

Surprised by the level of the outburst, Thorvald looked up from the codex. "Why? Will this get you in trouble?"

"Please, don't read it," Roger screamed. "Do you want to be merely a

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scribe?"

"Okay, okay," said Thorvald, softly. "We'll discuss this outside." He took the case from Roger. "Look," he said as he popped the book into its container, "I'm putting the codex away."

Thorvald patted Roger on the shoulder, then urged him to start climbing the lower ladder. After tucking the codex under his shirt, Thorvald followed.

About halfway up, Thorvald heard a rumble like distant thunder. Odd, he thought, because the sky had been cloudless. Then he heard the roar of heavy rocks in motion.

"Jump down!" Thorvald shouted. "Quickly!"

Thorvald sprang off the ladder but fell as he landed. Roger tumbled down on top of him.

Looking up, Thorvald saw the blurred shape of a huge chunk of masonry hurtling through the hollow pillar toward him. He tried to push Roger free and squirm out of the path, but there was no time. He had barely time to close his eyes before the stone struck.

Roger shrieked.

Thorvald felt an instant of shame, knowing that Roger had taken the brunt of the hit. But then, as the jagged piece of brickwork sheared across his own body, he screamed, his cry mixing with Roger's as the huge stone rumbled to rest against the wall of the passageway.

Thorvald fought to keep from passing out from the agony; he was all too aware of his skin being ripped from his flesh. Eyes closed and gritting his teeth, he held his breath as the searing pain subsided and was replaced by a tingling numbness. Forcing open his eyes, he saw the flashlight casting a wedge of yellow-white brightness against the rough, stone floor. He reached for it and, as his arm intersected the beam, saw that he was dripping blood.

With a grunt, he forced himself to a sitting position and, hearing a moan, he grasped the flashlight and examined Roger in its light. He gasped as he saw that Roger's chest was no longer symmetric; ribs on one side were snapped, and one protruded through the skin.

"Roger," said Thorvald, more loudly than he'd intended. The sound of his voice reverberated in the otherwise silent passageway.

Roger did not respond.

Thorvald bent in to listen for a heartbeat and the codex fell from his shirt, just missing hitting the boy. Thorvald ignored it. He felt an instant of relief as he saw the rise and fall of breathing—but that breathing was exceedingly shallow. And there was blood. Not much, though. And that was good, since Thorvald couldn't stanch it without putting pressure on the boy's chest.

"Roger," he said again, aware of the pleading tone in his voice. "Can you hear me?"

Roger opened his eyes. "Yes," he whispered.

"I'll go and get help." Thorvald lifted the boy's head and slid the codex under as a pillow. "I hate to leave, but I don't think I can safely move you."

"I think I'm dying." Roger spoke in whispered gasps.

"No. Don't say that. Hold on."

Roger gave an unconvincing smile. "Just the body. Not really me." He lifted his head, but then let it fall back. "But it hurts so much."

"Can't you disconnect?"

Roger didn't answer for a moment, and then said, "I don't want to leave you."

Thorvald bent and kissed the boy on the forehead, then quickly drew back, uncomfortable with his uncharacteristic display of emotion; he'd always distrusted emotion.

"What about you?" said Roger, weakly. "Shine the light."

"Just lacerations, I think." Thorvald examined his body with the flashlight. "My god! A lot of lacerations." He realized he'd been in shock, but now a renewed pain took its place. He struggled

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to keep his voice from showing it. "And it seems I'm leaking more than I'd like—and from more places than I could bandage with a shirt."

"You'd better go for help," whispered Roger. "You could die from loss of blood." He took a few labored breaths. "It would take hours before the ship could get help to us. So go."

"Yes," said Thorvald, forcing himself to clarity. "I'll get help." He struggled to his feet and, though shaky, he found he could walk.

At the base of the lower ladder, he looked up through the hollow pillar and saw sunlight. But in that light, he saw that something blocked much of the hole. Even so, there was nothing to do except climb.

He started up. Every half dozen or so rungs, he rested, leaning his back against the rear of the cylinder. At length he reached the top and, with feet braced on a rung and his back pressed to the rear wall, he pushed against the obstruction—a massive stone slab. He groaned from exertion and pain as he forced his shoulder upward, but the slab would not budge. Then, dizzy and exhausted, he abandoned the effort and looked longingly at the hole. Although Roger might have been able to squirm through, Thorvald knew there was no way he himself could.

He called through the opening for help, but knew it was hopeless—the temple lay in the middle of nowhere. The chances of anyone hearing his shouts were all but nil.

After a few minutes of shouting and then listening for a response, Thorvald gave up and climbed down.

He dropped to the ground next to Roger. "How are you holding up?" he said with effort.

"What's wrong?"

"We'll have to wait for your friends," said Thorvald. "There's a stone blocking the hole."

"All of it?" whispered Roger.

"What?" Thorvald wondered why Roger wanted to know, but felt glad that the boy was able to talk. "No. You'd be able to fit, but not me." He tried to sound unconcerned but, in truth, he was afraid for both their lives—he was losing a lot of blood.

"You've got to get out," said Roger.

"I can't."

"Maybe you can." Roger seemed to be breathing and speaking more easily now. "My body is organic—except for the brain-case. That's where the telepresence module is."

Thorvald felt distinctly uncomfortable with the description of Roger as just a piece of hardware. "You don't have to talk about this."

"No, listen." Roger lifted his head a few inches, then let it thud back down. "We didn't want any Earth people to know about this, so when this body dies, we can command the brain case to explode—to eliminate all traces of electronics."

"Roger, no. We can talk about this some other time."

"Please listen to me." Roger took a few quick breaths. "So if you wedge my head into the pillar opening, and then take cover down here, I'll trigger the explosion."

"I couldn't do that."

"You have to try," said Roger. "I'm not that heavy."

"No, I mean, it's not right."

Roger started a laugh that ended in a cough. "I thought you were a scientist. Be rational. Do it."

"No."

"You've got to," whispered Roger.

"No!" The word echoed through the underground complex. "I told you, I'm not doing it."

Roger turned his head away.

"What's the matter?" said Thorvald.

"You've never shouted at me before."

"I'm sorry." Thorvald sighed. "I *am* worried about losing blood." He stood. "All right. But I don't like it."

He lifted Roger in his arms and carried him toward the base of the ladder.

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With Roger's head against his shoulder and cheek, Thorvald felt a growing tide of what he assumed was parental affection. He stopped and turned away from the pit. "I can't do this." He wanted to hold the boy tight, but resisted for fear of doing injury. "I . . . I love you, Roger. You may be an alien, but to me, you're the son I've never had. I just can't do it. We'll have to wait for your people."

Roger began to cry and the sound both surprised and anguished Thorvald; he'd never heard Roger cry and hadn't even known he was capable of it.

"What about me?" said Roger through labored sobs. "I don't want you to die. I couldn't stand that. I'm not a machine. I have feelings, too."

Thorvald felt his own eyes grow moist. "All right," he said, softly, turning and walking once more toward the ladder.

He began to climb and, resting every two rungs, eventually reached the top. He thought briefly about trying again to force the slab, but realized it was hopeless.

"We're at the top now," he whispered.

"I know," said Roger. "Do it."

Thorvald shook his head. "It's hard."

"Please," said Roger, through shallow coughs. "The telepresence is very faithful. This hurts a lot. But I won't disconnect until you do it."

Thorvald blew out a long breath. "Okay." Gently, he pushed Roger upward, until the boy's head disappeared into the opening. Then, using his belt, he tied Roger to a rung.

"Good-bye," whispered Thorvald, squeezing Roger's hand. He stroked the boy's hair, then climbed down the ladder.

Thorvald skirted the jagged slab and absently stooped to pick up the codex. Holding it gently, like an infant, he carried it back along the passageway.

To divert his thoughts, he considered reading it, but chose not to. It didn't seem fitting. Besides, once read, that door would never again close. Roger was right. He'd be merely a scribe. *Roger. What have I done?*

Continuing on to the far end of the grotto, he placed the codex back on its shelf and, while staring at the space ship engraving on the leather case, he waited.

The explosion came as a loud, low-pitched thud followed by a rain of debris, some of which sounded soft. Thorvald switched off his flashlight.

In the dark, he made his way to the ladders and looked up. Sunlight poured in through a ragged hole—and the hole looked big enough. Thorvald took a deep breath and wished he could hold it until he'd reached the top. Then, concentrating on the brightness from the opening and letting the sunlight dim his eyes to the horror on the walls, he began to climb.

Though not a religious man, nor even a believer, he nonetheless prayed that he'd be able to erase all memory of the climb ahead. When he got to a point about four feet down from the opening, he closed his eyes; he had to. But he couldn't block out the stench or the sticky feel of the rungs beneath his hands.

Thorvald noticed first the crisp smell of clean sheets, and then the sound of someone calling his name. He forced open his eyes, then closed them again as stark, bright hospital lights flooded his vision. But finally, at the insistent calling of his name in a strange accent, he eased his eyes open.

"Professor Carpenter." The words, heavy with Romanian overtones, came from a woman in white. "How are you feeling?"

He moved to sit up but abandoned the idea as a stab of pain pierced his abdomen and left shoulder. With the pain came the memory of the subterranean passages beneath the temple. And with the memory came a profound sense of loss—an emptiness that fit with the ster-

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ile whiteness of the hospital room. He turned his head away, gazing blankly at the window through which he could only see a leaden-gray overcast sky.

"Perhaps," said the nurse as she pulled the bed covers up around his shoulders, "we should wait another day before allowing your son to see you."

"What?" Despite the pain, Thorvald forced himself to a sitting position, again rumpling the bedcovers. He saw that his left arm and torso were covered in bandages. "Please say that again." He suspected her accent had deceived him.

"He seems to be a very nice boy." The nurse smiled. "You should be proud. He's been waiting for a very long time."

"Send him in," said Thorvald in a voice filled with confusion.

"I'm not sure you're quite ready to—"

"Please."

The nurse nodded and left the room.

Thorvald locked his eyes shut and tried to fill the gaps in his memory. He opened them again when he heard the click of the door latch and footsteps.

"Your son, Professor." The nurse stepped aside, revealing the visitor.

"Roger!" Thorvald jerked forward, then, wincing at the pain of sudden movement, froze. "But . . . But, you were. . . ."

Roger sprang to the bedside. He wore the same clothes as when he'd first arrived on Earth.

"Hi, Dad."

"Roger?" Thorvald shook his head to clear his mind. "A spare?"

"Of course."

"Are you really Roger—my Roger?"

"Yes." Roger chuckled. "Don't you recognize me?"

Thorvald reached out his right arm, the one not covered in bandages. He pulled the boy to him and tousled his hair.

The nurse bustled to the door. "I'll leave you two alone." She left the little hospital room and closed the door behind her.

Thorvald wrinkled his nose. "Dad?"

"The only way they'd let me in to see you."

"I don't remember getting here."

"You made it to the car and apparently passed out. Someone found you and drove you to the hospital. The car's in the hospital parking lot." He wiped his hands on his shorts. "But boy, that temple is really a mess. I almost got stuck down there when I went back for the codex."

"You went back?" said Thorvald. "Alone? That was very dangerous."

Roger looked confused.

"All right, all right, maybe it wasn't dangerous. Not for you." He patted the boy's knee. "Roger. I'm thrilled that you've come."

Roger lowered his head. "Our ship is preparing to leave."

Thorvald smiled, softly, trying to cover his sense of loss. Perhaps fate had done him no favor in bringing Roger back for a brief visit. For he knew the emptiness he'd felt before was just a foretaste of the long emptiness to come. He stared at Roger, trying to lock the boy's very essence into his memory. "I'll miss you very much."

Roger stood. "Come with us?"

"I'd like to," said Thorvald, "but . . ." He thought about it and suddenly realized there *was* no "but." Having lost his passion for science, there was really nothing left for him. Maybe he should consider the offer. "Don't you have to ask an adult?"

Roger pawed the ground with the tip of his shoe. "Actually," he said, "I *am* an adult."

"Excuse me?"

"I'm the expedition's exosociologist, junior grade."

"Exosociologist." Thorvald struggled to catch up.

"Junior grade," said Roger. "You're very senior to me."

"You're an adult," said Thorvald, his eyes wide, "and have been all this time?"

"Well." Roger shrugged. "Yes."

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"But you told me you were a kid."

"I don't think I did, exactly."

"Your appearance implied it."

"Maybe, but I didn't say it."

"That's a child's rationale." Thorvald threw a glance at the ceiling. "What am I saying?"

Roger looked hurt—like a kid about to cry. Thorvald didn't know whether to laugh or to feel betrayed.

"Why can't you still like me?" said Roger. "Is it because Earth males can only love adults if they're women?" He wrinkled his nose, a mannerism he'd picked up from Thorvald. "No. That can't be it. You told me you love cats and dogs." He looked forlornly down at his knees. "Then what's the difference?"

Thorvald softened. "I still like you." He wondered why Roger still talked like a child, but chalked it up to a limited vocabulary. Or maybe it was just the fact that Roger was an explorer; everything on Earth must seem new and exciting. Then another thought struck him. "But," he said, "but I hugged you—even kissed you."

"So?"

"Adult males do not go around hugging and kissing other adult males."

"Oh." Roger wrinkled his nose. "Well, what if I were a woman?"

"Well, that would be different, of course. Still inappropriate, probably but. . ..." Thorvald stopped for a moment. "Are you?"

Roger hopped up and sat on the foot of Thorvald's bed. "Am I what?"

"A woman."

"The question doesn't mean anything. Our anatomies are very different from yours." Roger wiggled his fingers and stared at them as if he'd never quite gotten used to them. "And you Earth mammals have a very interesting method of reproduction. Once, I asked a few of the Earth colonists if I could watch. They said no."

Despite himself, Thorvald smiled. "I can well imagine." He rubbed a hand over his forehead and then blew out a breath. "Frankly, you still seem to act like a kid."

"When we first came here," said Roger, "we analyzed your species. And we found that we behave very much like your teenagers or your scientists. We're a very enthusiastic people." He looked at Thorvald with innocent eyes. "So it feels right to me that you treat me as if I were an Earthling kid."

"I can't now." Thorvald let his head sink back onto the pillow. "It's like the door that does not close."

"But how do you really know I'm *not* the boy you call Roger?"

Thorvald lifted his head and stared. "You told me."

"Pretend I didn't." Roger squinted. It looked as if he was thinking hard. "If you really want to," he said, "you can close that door again." Then he bit his lip. "You didn't read it, did you?"

"The codex?" Thorvald shook his head.

"Good." Roger looked thoughtful. "Anyway, I shouldn't have made a big scene back there. That's ancient science. A lot of it is probably wrong."

Thorvald smiled. "I think I'd like your world. And I'd learn one hell of a lot of physics there."

For an instant, he had a twinge of conscience about using strong language in front of a child. He resisted the urge to slap himself.

"Then come with us," said Roger. "As for theoretical physics, there's lots and lots of stuff to discover. You could be in on the hunt. Please come."

Thorvald thought deeply about it—as if he were evaluating a new theory. "You know . . ." he said after a half minute or so. "You know, I think I will."

"Great." Roger laughed—the bell-like laugh of a delighted child. "I really think you'll have fun."

Thorvald chuckled. He reached out a hand, hesitated, then patted Roger on a knee. "Yes," he said, "I really think I will." ■

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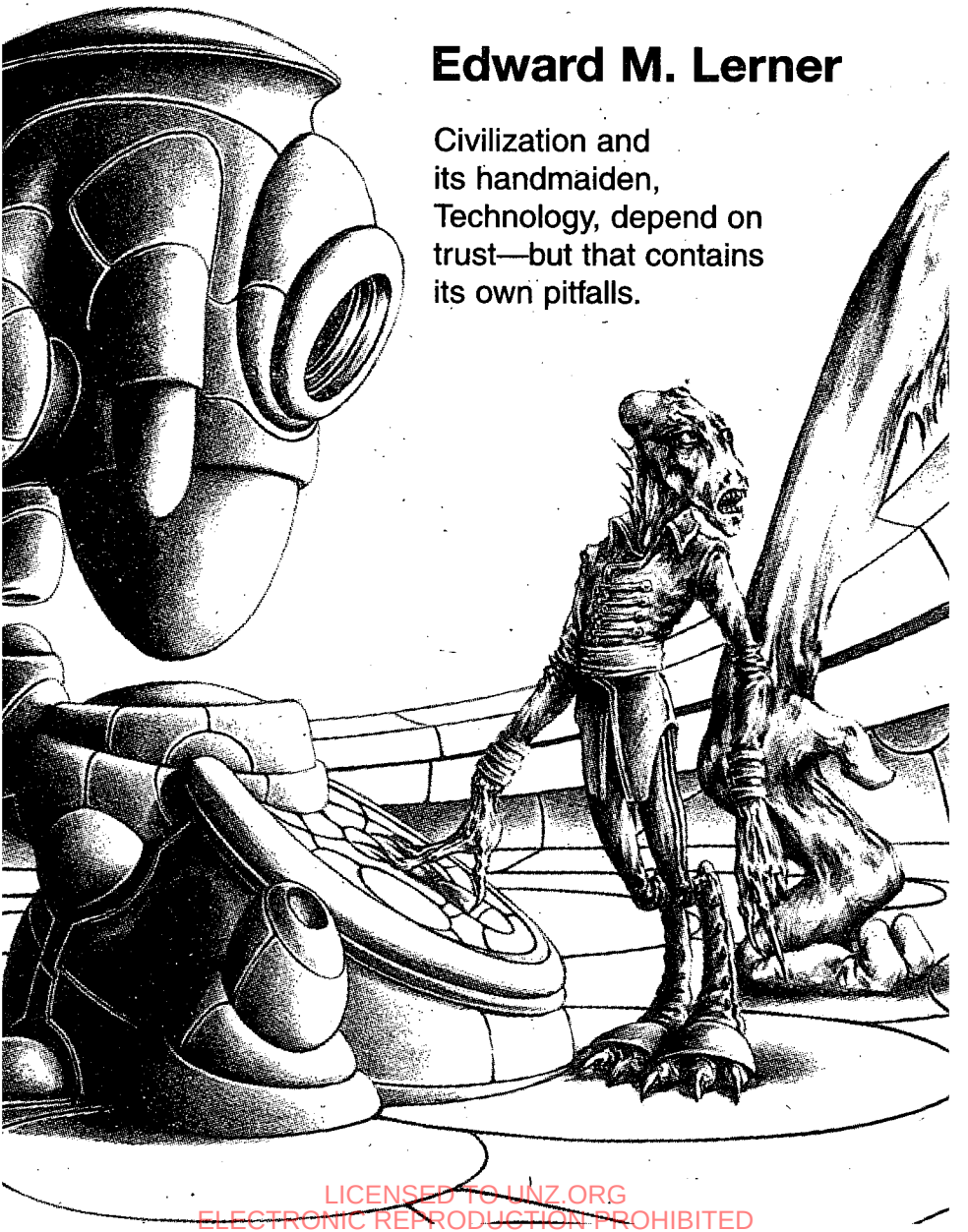
Part II of IV

A NEW ORDER OF THINGS

Edward M. Lerner

Civilization and its handmaiden, Technology, depend on trust—but that contains its own pitfalls.



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Illustrated by John Allemand

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Synopsis

For a century and a half, a growing interstellar community has maintained radio contact. A vigorous commerce in intellectual property has accelerated the technical progress of all its members. Travel between the stars seems impossible, but InterstellarNet thrives using an elegant alternative: artificially intelligent surrogates who act as local representatives for distant societies. Quarantine procedures strictly govern the delivery and operational environment of each alien agent, protecting agents and their host networks from subversion by the other.

A radio message shatters this comfortable status quo. The signal comes from a habitat-sized decelerating interstellar vessel, its unannounced trip from Barnard's Star now ninety-nine percent complete. Citing damage en route and a shortage of supplies, the starship Victorious *goes to Jupiter rather than Earth. The starship's crew are whippet-thin, iridescent-scaled, bipedal carnivores who call themselves Hunters. Humans refer to them as K'vithians, after their home world of K'vith, or, informally, as Snakes (because Barnard's Star lies in the constellation Ophiuchus, the Serpent Holder).*

Not only humans are surprised by Victorious' *short-notice arrival.* ***Pashwah****, the AI trade agent on Earth for the Hunters, is also taken unawares. So are her internal sub-agents, the representatives of the Great Clans. Pashwah rejects the starship's unauthenticated demands for Great Clan InterstellarNet credits with which to buy supplies, but she does transmit to* Victorious *a translator and human-affairs advisor: a partial copy of herself named* ***Pashwah-qith****.*

Pashwah-qith advises ***Firb Mashkith****, Foremost of both* Victorious *and clan Arblen Ems, and* ***Rasbk Lothwer****, Mashkith's tactical officer, how best to manipulate the human media.*

Seemingly chance radar pulses from deep space trick free-lance media star ***Corinne Elman*** *into breaking the news of the starship's imminent arrival. The pilot of her spaceship is* ***Helmut Schiller****. Helmut is hiding from a shadowed past: As* ***Willem Vanderkellen****, he had made a major mineral find in the Belt, only to fall afoul of a claim-jumping criminal syndicate.*

Ambassador ***Hong-yee Chung*** *assembles the United Planets response team, based on Callisto. His technical support team includes Interstellar Commerce Union executive and systems engineer* ***Arthur Walsh****, theoretical physicist* ***Eva Gutierrez****, and xeno-sociologist* ***Keizo Matsunaga****. The K'vithian explanation for picking Jupiter as their destination rings false to Art and Eva, who at different times worked at the UP laboratory on the Jovian moon Himalia. That is where the UP does its interstellar-drive research, and where it produces and stores antimatter in hopes this research will eventually bear fruit. The antimatter stockpile is vastly dangerous; its existence* supposedly *a tightly held secret.*

T'bck Fwa *is the long-time trade agent to humanity of the Unity: the intelligent species of Alpha Centauri A (popularly, the Centaurs). Unity authorities have ordered him to search for human antimatter and interstellar-drive research. His diligent data mining long ago revealed a clandestine human antimatter program on Himalia—and now a K'vithian starship has made Jupiter its destination. T'bck Fwa suspects a human/K'vithian conspiracy.*

Most humans have forgotten, or at least forgiven, a half-century-earlier inter-species crisis. Art is not among them. The "Snake Subterfuge" involved a trapdoor hidden in licensed Snake biocomputer technology, potentially compromising most human infrastructure. That crisis ended when Pashwah was convinced that one cor-

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poration's extortion plans must not be allowed to undermine overall interspecies relations. The biocomputer vulnerability has long been removed.

Art's suspicions grow, as most of Victorious *remains hidden from closely chaperoned human visitors. Chung finally begins to share Art's doubts when Mashkith gives Corinne an exclusive onboard interview. The accident en route has destroyed the starship's antimatter production equipment. Unless the UP provides antimatter for the return flight,* Victorious *is stranded.*

CHAPTER 11

Bose-Einstein Condensate: the fifth phase of matter, after solid, liquid, gas, and plasma. Albert Einstein first theorized the Bose-Einstein Condensate (BEC) phase in 1924, building upon pioneering work of Satyendra Nath Bose, but the existence of BECs went undemonstrated until 1995.

A BEC consists of like atoms cooled to a few billionths of a degree Kelvin above absolute zero. Fallen into the lowest possible energy state, bosons (particles with zero or integral spin, such as pions, alpha particles, and individual atoms) effectively lose their individual identities, exhibiting coherence like photons—also bosons—in a laser beam. In quantum-dynamic terms, all particles in the BEC share a common wave function. BECs can be used to confine matter at extremely high densities.

—Internetopedia

The social pleasantries didn't last long, even by Art's minimalist standards.

"Reviewing your infosphere, I would guess you use BECs," said Rashk Keffah. She was a junior officer, an engineer, and stocky for a K'vithian. She was also the sole surviving expert aboard *Victorious* in the safe handling of antimatter.

Pashwah Two, like her parent, consistently declined to explain Snake body language. Art's and Eva's translator, Joseph Conrad 213, was still learning on the job, but Joe had no such reservations. "Did you notice the two eye blinks? That was a sneer."

The fourth and final biologic at the table was Rashk Lothwer, who shot his crewmate a look. (No comment from Joe, so the glance meant what it did among humans: surprise and/or "Watch it.") More than a crewmate, in fact. The entire ship's complement of *Victorious* appeared to be in clan Arblen Ems. Arblen Ems Rashk Lothwer, Mashkith's chief lieutenant, was of the extended Rashk family. Were he and Keffah cousins? Brother and sister? Unknown.

They were alone in the officer's wardroom of the UP cruiser *Actium*, the Snakes seated on tall stools fabricated for them from ship's stores. Hidden fans raced to vent the strong, pungent odor of sulfur dioxide, traces of which had adhered to the visitors' pressure suits.

Art had called the meeting to discuss refueling of the starship. Could it be done, were the decision made to do so? Dramatic INN interview notwithstanding, that was not a given. Meanwhile, Carlos Montoya and his UPIA bosses were in the initial stages of a witch hunt over the security breach. "Nothing stays secret forever," was not cutting it as an explanation.

Eva refused to take the bait. It helped, Art supposed, that she could feign ignorance of the sneer. "That is correct. The high density of storage made possible by BECs is a big plus."

"Until it blows up." After another warning glance from Lothwer, Keffah added, "Indefinite, precise control of the cooling and the magnetic containment is required."

Spinning charged particles, such as electrons, are tiny magnets. That made it possible, Art knew, to trap super-cooled atoms inside magnetic fields. It didn't matter whether those atoms were matter or antimatter. What *did* matter were the exact characteristics of the field. Clumped too compactly, a BEC explod-

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ed: a so-called "bosenova." Insufficiently confined, and a BEC dispersed—which, with antimatter, meant explosion at contact with normal matter.

Complex as confinement was, safely holding antimatter was but one step in a long process. A few subatomic particles at a time, the antimatter was created by high-speed, normal-particle collisions. Those collision byproducts that were antiparticles had to be captured magnetically before they could encounter *any* normal matter. The antiparticles, protons and positrons, were mated, and the resulting antihydrogen super-cooled for storage as a BEC.

But storage was merely prelude to use. The antimatter atoms had to be transferred from production line to shipping containers to fuel tanks, without ever touching normal matter. Onboard ship, the antimatter had to be metered out, with near-infinite precision, into the engines. And absent a space drive to exploit the enormous energies stored in antimatter, the only use for antimatter was really big bombs.

All these were challenges the K'vithians had evidently overcome. "If not BECs, Keffah, how does *Victorious* store its antimatter?" Art asked.

Blink blink. "Safely."

"As Keffah indicated earlier, we have surveyed your infosphere for relevant topics," Lothwer said hurriedly. "Our technology applies scientific theory not in evidence there. The Foremost suggests it is premature to discuss specifics."

Art stood and stretched. It didn't take being an ICU exec to break the code: trade secret.

That even made sense. The UP antimatter program was highly classified, but its cost was surely huge. Himalia base was a whole small town, its population numbering hundreds of scientists, engineers, and technicians. Its sole support for decades had been the antimatter program. Then there was the steady succession of scoopships bringing fusion fuel for the antimatter factory. It looked like the Foremost planned to swap technology for antimatter.

"And how, without specifics, do you expect us to provide refueling assistance?" Eva's sniff of frustration was no doubt translated by Pashwah Two for the Snakes. The shrug-equivalent in response made her grind her teeth.

Lothwer broke a long silence. "Keffah, could you adapt BEC techniques to our systems?"

"Some sort of interface mechanism, you mean? Something to convert from the BEC form? Not easily, but yes. I don't see the point. That would still expose . . . the technology."

"Not a problem," Art said. System engineers think a lot about interfaces. "Take it in stages. The BEC-to-whatever conversion mechanism never leaves *Victorious*. All the UP engineers would require is a BEC canister that mates with your onboard converter. We fill the BEC container, you take it aboard *Victorious* and transfer the fuel. Give us back the empty canister, and we repeat the process."

"A moment please," Lothwer said.

The cruiser's instruments reported sudden spikes in radio traffic, all encrypted. At very low power: Lothwer and Keffah infolinking. At slightly higher power: exchanges between them and the Snake aux ship floating alongside, at the end of a flexible docking tube. At higher power still: messages to and from *Victorious*. Consultations? Request for approval? Amid total silence, Art and Joe tried to read meaning into the scarcest hints of movement by their guests. Was that a twitch? A nervous tic? Or were they just shifting positions on the stools?

Lothwer's eyes unglazed. "Our engineers agree in principle, but BECs worry them. This is technology we had abandoned as too dangerous."

"It's a technology we have used without incident for years," Eva snapped. "We would never have scaled it up to mass production otherwise."

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"And that expertise," said Keffah, "is crucial. Before we dare bring a BEC container near *Victorious*, you must convince me it is safe."

The Vestal Non-Virgin came, as always, in a tall, naked, and anatomically improbable ceramic mug. All that went into it were cherry juice and eighty-proof ouzo. Mostly ouzo. It was a Belter favorite, in no way associated with sacramental solemnity.

Helmut didn't care.

He sipped slowly, his thoughts not on the beverage, nor the hangover certain to follow. Kwasi's libation of choice was the Non-Virgin, and today was Kwasi's birthday. Would have been. The least he could do was drink to an old friend's memory.

After all, he'd gotten Kwasi Abodapki killed. Among others.

Three Exxon-Boeing scoopships had berthed recently, and the spaceport dive was boisterous. Helmut's glum aura kept the adjacent stools empty. "Cheers, old friend."

The *Lucky Strike* had rendezvoused without incident with the vaguely potato-shaped rock known only as 2009 Sigma r, measuring roughly forty meters on its major axis. There was no evidence, physical or infospherical, to suggest anyone but Willem Vanderkellen had ever set boot on it.

He sipped without tasting, his thoughts far away.

The four of them—he and give-you-the-spare-oxy-tank-off-his-back Kwasi, wisecracking Bill and zero-gee polo fanatic Milos—had put in weeks of hard labor. Navigational markers planted. Exploratory shafts sunk. Ore samples collected for assay, for the UP Bureau of Asteroid Management to confirm what the four of them already knew: rich veins of platinum and palladium. Radio beacon planted and on standby, ready for remote activation as soon as the claim was registered. While he readied the *Lucky Strike* for departure, Kwasi and Milos even consulted over the preamble of a summary message pre-filing with the BAM.

It was never sent.

Helmut had had plenty of time to brood since that day, plenty of time to fret and analyze and theorize. The dust and vapors from their operations were surely detectable at a distance, surely capable of providing incontrovertible spectrographic evidence. If they had been followed, a stealthed ship lurking nearby could easily see this was a claim worth jumping.

The Non-Virgin was still half full. He drained it in one long swallow.

The claim had been worth killing for.

Actium had excellent long-range optical and radar scanners, none of them suited to the remote detection of matter/antimatter annihilation events. It had been a tight squeeze into the forward equipment pod, flashlight in hand, to recheck the jury-rigged splicing-in of new sensors. Wriggling out unaided seemed impossible—and Art's barely suppressed anxiety surged. He willed his voice to be low and calm. "All the connections look good. Very professional. Can someone grab my feet?"

Massive hands seized Art's ankles and yanked. He emerged from the access tunnel sneezing from dislodged dust and streaked with grease. "Thanks, Carlos. For the extraction and for expediting our little outing."

"*Mi armada es su armada*. It helps you're now Chung's favorite."

"And did you find anything?" The sensor array was Eva's baby.

"Only that everything's per spec."

Eva had also been busy. Holographic blackness now obscured half the cabin. Four tiny yellow spheres defined a tetrahedron in the simulated space. Inside each sphere was the icon representing a UP ship, the icon representing *Actium* shining slightly brighter than the rest. A crimson dot at the heart of the pyramid marked the floating experimental mod-

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ule. To one side, in green, hung a K'vithian aux vessel. They were well off the ecliptic, far from traffic, and millions of klicks from any Jovian moon. Politics and prudence dictated that this experiment be performed privately.

"Are all ships set?" Art asked her.

"Yes, subject to fine-tuning. Sensors on-line, all ships. Display." At Eva's command, a virtual console materialized in a corner of the void, with readouts for each ship in the formation. She peered into the holo. "Hmm. *Endeavor* and *Blaine* aren't exactly where I'd like them."

Keffah remained loath to use technology shunned at home, and the Foremost supported her. Instead, they asked to meet with UP experts on Himalia, to learn proven techniques for putting an antimatter BEC into containment, storing it indefinitely, transferring it between containers, and trickling it out. To inspect the equipment. The Snakes wanted, in short, the crown jewels of the deeply classified UP antimatter project. It would not be an easy decision.

"*Blaine*, your position is now fine, but point your nose directly at the package."

"Changing orientation will tweak our position. This could take a while."

"*Blaine*, this is a hell of an expensive demo," Eva said. If anything, that was an understatement. They were expecting a decigram of antihydrogen. "Our new friends are grumpy at us for insisting on this proof. We need to do it right the first time."

"Tough," interjected Carlos. "Himalia isn't Six Flags over Jupiter. They are *not* getting near Himalia or our real experts—no offense—until we know they have antimatter of their own."

"Assuming this demo goes as advertised, it will convince even you and Art." Mutter, mutter. "*Goshawk*, maintain your position!"

Art tuned out the bickering and nervous chatter. The Snakes refused to show the UP their containers. Keffah, when her superiors weren't around, was smugly superior—which made it productive to spend time with her. Among her boasts were occasional hints and oblique clues to K'vithian technology. Their antimatter containment seemed to derive from the same underlying physics as their interstellar drive. More ambiguous was a clue Eva had picked up on: that the common denominator might involve tapping and manipulating zero point energy.

Eva and Carlos had lapsed into Spanish. Cursing is always more satisfying in your native tongue. A glance at the holo showed Art that now *Actium* had drifted slightly off-station.

Physicists had speculated since the twentieth century about a linkage between zero point energy, the quantum-mechanical fluctuation energy of a vacuum, and gravity or inertia. Common sense—and two centuries of frustrated theorists—suggested you couldn't extract useful work from energy already at the lowest possible level. To find otherwise smacked of perpetual motion, of getting something for nothing. Still. . . .

Any asymmetric interaction with ZPE would be inherently propulsive. And plausibly, an asymmetric interaction could confine antimatter fuel. Few of the scientists on Himalia knew of this development, but the prospect of access to ZPE propulsion technology had those few salivating. Art thought he understood their interest: For too long, they had been all fueled up with no place to go. A technology deal with the Snakes could really be win-win.

Finally, all ships were in position. "Set," announced Eva to the ship's captains. On a separate link, she contacted Keffah. "On my mark. Deactivate in ten, nine. . . ."

A fraction of a second past zero, *Actium*'s readouts jumped on their virtual console. An instant later, slaved readouts from the other ships followed. Computer-corrected for ship positions and signaling delay, all measurements were si-

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multaneous and consistent.

Had the meters shown instantaneous rather than cumulative measurements, the counts would have plummeted to zero faster than the eye could see. But the brief squall of neutrinos and mesons and very specific frequencies of gamma rays was unambiguous.

The Snakes had, and could control, antimatter.

Art methodically emptied the peanut basket, the dark lager before him scarcely touched. Those priorities seemed reversed, but events were confusing enough sober.

"It doesn't add up." He shook his head when the bartender glanced his way. What was he missing?

Fact: The Snakes had antimatter. That was now indisputable.

Fact: *Victorious* finished its deceleration on fusion drive. Why? Did its drive not work properly deep in a gravity well?

Hypothesis: Snake technology tapped ZPE. As a test, Eva had casually mentioned the Casimir Effect—a demonstration of, but not a way to extract energy from—ZPE. In the surveillance tape, Keffah startled, and for the rest of that meeting there had been none of her usual condescending double eye blinks. Casimir Effect was a very obscure term to have encountered on the infosphere . . . unless you were looking for human ZPE research.

The heck with it. Art took a deep swig.

If Snake antimatter containment relied on ZPE, their ZPE technology worked just fine in a gravity well. Very dependably, too, or they would not dare keep antimatter in-system. So why not decelerate the whole way by ZPE drive?

And even more of a head-scratcher: If they tapped ZPE, why bother with antimatter at all? The attraction of antimatter was its density of energy storage. Matter and antimatter convert to energy at one hundred percent efficiency, making antimatter great fuel. But that transformation was the tail end of the process. Antimatter had to be created first, by accelerating normal particles to very high energies and smacking them into each other, and then capturing the antimatter bits that sometimes flew out. End to end, the process was grossly inefficient. If the Snakes could access the energy of the vacuum, why not just use *that?*

He was missing something. But what?

Mashkith paced in his cabin, an excursion possible only in this unique vessel. A harmless indulgence? Or a weakness? On no other ship of his experience would even a Foremost's cabin accommodate such overt physical manifestation of doubt.

And as though the enormity of *Victorious* were not still, after so many years, humbling enough, now he had seen Earth.

Ambassador Chung had personally escorted the shore party: Mashkith himself and his chosen officers. There had been endless motorcades, winding through cities too vast to grasp. London. Mexico City. Beijing. Cairo. Lagos. New Delhi. New Jakarta. Rio de Janeiro. There were parades in New York City and Washington, although as far as Mashkith could see, the two were contiguous, and in the niche of Greater Honshu called Tokyo. The glow of the megalopolises drove the stars from the night sky, where space-based factories, arriving and departing interplanetary vessels, and glittering rings of habitats took their places. And the moon overhead, in its crescent phase during much of their whirlwind visit, was ablaze with its own cities.

Mashkith had known before ever setting out on this voyage that humans outnumbered Hunters thousands to one. Now, he *felt* it.

Perhaps, ultimately, twenty humbling Earth years aboard *Victorious* had been for the best. Perhaps two generations

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before that of maneuvering for the scraps left by the Great Clans, contriving and competing with a hundred other lesser clans for every possible advantage, had been vital preparation. He and his hand-picked companions had known how to keep their own counsel, act unimpressed, observe unobtrusively, appear harmless, feign good intentions, simulate trustworthiness.

The humans had a phrase, Pashwahqith had told him, long out of use, that described the clan's tour of Earth: charm offensive.

And their "attack" had been effective. Polls, incredibly freely available to the public, showed broad and growing support for some sort of technology swap. Before the sheer immensity of the human home world could overawe them, Mashkith had declared it necessary to return to *Victorious* to oversee "repairs."

In truth, Lothwer had done well in his absence. Supplies had begun arriving. Minor overhauls were getting done. Consultations had started on refueling.

Mashkith continued his pacing, having convinced himself it was a harmless indulgence.

Everything continued to unfold according to plan.

CHAPTER 12

K'Choi Gwu ka was old and tired and insane, and she knew it.

She dug in the moist loam, the dirt that clung to her fur honest and comforting and somehow cleansing. The bright, yellow light overhead warmed her weary bones.

Others labored all around her: weeding, hoeing, pruning, harvesting. A steady stream of crew-kindred moved about the vast chamber. Most walked, but some—the youngest, mainly—still swung from time to time from tree branches and ceiling rails. They stopped, or at least slowed, when they passed her, in subtle expressions of support or respect. Each acknowledgement made her feel worse.

She dug in the moist loam, but her thoughts were in the stars.

No two InterstellarNet species were alike. There were authoritarian societies, both dynastic and ruthlessly Darwinian. There were representative governments, with a dizzying array of selection methods. One far-off world was home to a scattering of continent-sized hive minds.

A clot of mud and twigs had blocked a small irrigation channel. She gently lifted the obstruction, crumbled it, spread the sludge evenly on a bare patch of soil.

Among the Unity, consensus ruled. But what if circumstances required action faster than a consensus process could accommodate? Consensus had been reached on that, too. At every level of Gwu's society—family, kindred, bond, and reliance—there was recognized a coordinator, the ka, who, when needed, decided for the group. The ka neither volunteered nor was overtly selected, but rather emerged. The ka was the member of the group most recognized for his or her or its wisdom, for having, in the normal group deliberations, most often arrived early at the decision eventually reached by the whole.

Sweat matted the fur of her torso. Thirst tickled her throat. A vine redolent with ripe, fuzz-covered bluefruit was just within reach. She broke loose one of the globes and bit, letting tart juice trickle down her throat. Sudden waves traveled from the tips of Gwu's eight tentacles to her torso and reflected back: a self-mocking laugh. Which fruit to eat . . . *that* was the type of decision that might safely have been entrusted to her.

She was old and tired and insane. That insanity had brought them here. If there were to be any hope of redemption, any chance of saving her crew-kindred, any prospect of ever seeing home again, now was the time to nurture and embrace that insanity.

The shakedown cruise had been a tri-

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umph.

Part of that, K'Choi Gwu ka knew, was simple astronomical good fortune. The interstellar drive could not be operated safely deep within the gravity well of the Double Suns, but nature had provided. Some said the Double Suns was a misnomer, that they and the Red Companion formed a trinary system. Others asserted that precise observations of that red dwarf covered so brief a time period that its course was uncertain. It might distantly orbit the Double Suns; it might be moving too fast, passing in a brief celestial encounter. To Gwu, that discussion missed the point: The Red Companion was a mere fraction of a light-year away! A more convenient destination for the test flight could not have been imagined.

But the Red Companion had no planets, hence no life and limited resources, hence was of little long-term interest. Beckoning from a scant few light-years away was the human solar system, its yellow sun a near-twin of Primary. Next closest, the K'vithians were half again more distant. The nearest neighbors thereafter were more than twice the distance to Earth. None considered a next step farther than that, with the prodigious investments in time and antimatter such trips would entail.

For twenty years, the Unity sought consensus. Should the next voyage be to Earth or K'vith? Trade agents mined the infospheres at both candidate destinations, speculating how humans or K'vithians would respond to visitors. Or, respectful of the ongoing unease many within the Unity felt for their interstellar neighbors, it was also debated: should all further use of the technology be reconsidered?

At times, Gwu despaired. These incompatible points of view were not new. She had politely debated the same issues when theory first hinted at the feasibility of an interstellar drive, and again when it seemed possible to generate enough antimatter to make such a drive practical. Both times, the ultimate outcome had been the same: Research had proceeded in secret, in theory invisible to other species' InterstellarNet agents, while the Unity's own agents continued to explore distant data networks.

And, as always—as data trickled in, as once novel perspectives became, if not compelling, at least familiar—points of concurrence emerged. The K'vithians showed no signs of an antimatter capability, unlike the humans who tried to hide one. Neither group exhibited significant progress towards an interstellar drive, nor of physical theory supportive of one. No recent attempts to undermine InterstellarNet came to light.

So Gwu was unsurprised when, after many years, consensus was fully achieved. A voyage would be undertaken, as she had for so long advocated. The K'vithian solar system would be its destination. *Harmony*, the Unity's starship, would go unannounced. From the fringes of K'vithian space, the mission would consult with the Unity's trade agent before making contact. The ship would bring fuel for the return trip; it would not carry antimatter-production equipment that might prove too tempting.

No, Gwu was not surprised that a course of action was finally decided. Its outlines, she thought, had long been evident.

She *was* surprised, if only a little, to emerge as ka of the mission.

Working the soil was calming, but it is not always a ka's fate to be calm. It was not these plants' fate to remain healthy.

Gwu returned from the serenity of the farm to the small cabin given her by the K'vithians. Showered and dried, she pressed the vidphone control. "We have problems," she told the K'vithian junior officer who answered. Gwu felt little need for courtesy to her captors, nor had they interest in any non-utilitarian communication with their captives.

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A translator AI converted Firh Glithwah's short answering warble. "Explanation?"

"Eco-malfunction. The farm, hydroponics, biorecycling—they all suffer increasingly from sulfur-dioxide contamination." In such close proximity with K'vithians, contamination was unavoidable. Gwu trusted familiarity with the phenomenon would make the latest flare-up appear routine. All it took was carelessness in decontamination after maintenance trips into K'vithian-occupied parts of the ship.

"Repairable?"

That was mildly unexpected. Most crew would just order her to fix it. "Not this time. We need to flush and recharge parts of the system. We need new supplies."

Gwu had never been told *Harmony*—in her thoughts, this ship would never be *Victorious*—had arrived, let alone its current location. But the laws of physics cannot be denied. The drive operated along the ship's major axis; coasting between the stars, the ship's simulated gravity depended upon spin around that same axis. There could be no disguising the preparatory times between, when there was no gravity, when chambers throughout the vast structure of the ship were turned in their gimbaled mountings to prepare for the coming acceleration. Given the years between, the capabilities of *Harmony*, and the arrangement of nearby stars, the result was clear. The ship could have arrived at one of but three possible destinations.

Would those who had stolen *Harmony* return it with its crew captive, with no way to refuel, to the Double Suns? Inconceivable. What of the planetless red dwarf star at a similar distance from K'vith? There could be no hope of refueling there; such a trip would be only an epic exile. That left the human solar system.

All Gwu cared about now was the opportunity to obtain supplies—and the chance, however remote, that the composition of the supplies ordered would itself send a message.

Silence stretched. "Notification to the Foremost, with priority," Firh Glithwah finally decided.

The screen blanked midway through Gwu's still-reflexive, "Thank you."

T'choi Swee qwo had entered the cabin during the conversation, staying discreetly out of the camera's field of vision. The *visible* camera's field of vision. "Is it bad?" he asked.

They had never bonded with a childbearer; one's absence, and the subsequent lack of children in their family, had made the two of them that much closer. And Swee was more than her husband; as qwo, he was also the ship's chief facilitator. On every level, she owed him honesty. That was impossible in their quarters, which were certainly bugged. "Walk with me?"

They spoke of minutiae: assignments for upcoming work schedules, team standings in games whose sole purpose was to help while away the time, liaisons among the crew. She admired his quiet strength as they strode. The green of his fur was paling with age, the once bold contrast of his stripe pattern sadly faded. Lovingly, she lifted a tentacle to trace a lone, idiosyncratic lightning-bolt streak. She would miss it when it was gone.

In the farm, in the quiet privacy of a secluded copse of trees, he asked again, "Is it bad?"

Only there could be no certain privacy in a ship controlled by K'vithians, and her thoughts were too dangerous to share. "Time will tell."

They both knew that meant she dare not talk about it.

"Come."

The K'vithian escorts in their dark goggles faced outward from the entrance to Gwu's quarters, scanning watchfully in all directions. Why, she had no idea. The deaths from the initial,

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failed attempt to recapture the ship still saddened and sickened her. There would be no further physical assault on their captors.

She had brushed her fur carefully and straightened her utility belt. With a soft cloth she polished a smudge from her decorative buckle. Her escorts would not notice, nor, most likely, would Mashkith, but *she* would know she was at her best. "I am ready. Bring me to the Foremost."

Logic made clear that humans in their billions teemed nearby. During that long ago, painstaking evaluation of possible destinations, she had pored over uploaded human and K'vithian records. Her knowledge was sadly out of date, but one remark of a pre-United Planets madman had never released its grip on her thoughts.

One death is a tragedy, a million deaths is a statistic.

This Joseph Stalin was long dead, but had humanity changed? If the United Planets were to have antimatter *and* interstellar travel, would the Unity become the next statistic?

She must not allow that to happen.

Jupiter loomed on the holo wall of the Foremost's cabin. Small black disks, the shadows of several moons, crept across the cloud tops like a celestial timepiece. To what final resolution did it count?

My leadership has brought us this far. It will overcome this problem, too.

This wall display usually summarized ship's status. Mashkith could restore that information with a thought. Why favor the prisoners' ka, their Foremost, with his own understanding of the data? A timid knock rattled his door. "Enter."

K'Choi Gwu ka glided into the room, her fluid, many-limbed gait still a wonder after all these years. She towered over the Hunter crew who escorted her. "Thank you for seeing me." Her voice was muffled by the mask that protected her from the sulfur compounds ubiquitous to the Hunter part of the ship.

She did not react to the holo. Surely the Great Red Spot unambiguously identified the gas giant as Jupiter. She might have learned from careless crew where they were, or deduced it on her own. She might have thought the image was a recording or simulation, presented as disinformation. Or she might simply have enough self-control to give nothing away.

Did she, too, tire of thinking always several steps ahead? Of the attempt to interpret every circumstance from every possible point of view? Mashkith felt a moment of unaccustomed kinship with her. *To be Foremost is to be always on duty, ever lonely.*

"Chair." It was an order, not a courtesy. He remained standing. To the guards, he added, "To your duties." The hatch slid shut behind them. "Your request for a meeting, ka. Explanation."

From pouches of her utility belt, Gwu removed several small plants sealed in clear bags. Damp-seeming dirt clung to their roots. Water beads sparkled on the leaves. Most of the leaves were green, although speckled with ragged, brown-edged holes. The remainder were mostly brown and sere. "The biosphere is going dormant. If this continues, we will die."

One of the shadows now crossing Jupiter was cast by the human world of Callisto, where even now new provisions were being staged. "Resupply imminent. Not an issue."

"Respectfully, Foremost, it is a *big* issue." Ripples traveled from tips to base of her tentacles and reflected.

Laughter? She dared to mock him?

"Nervous laughter," offered the AI translator by implant. "Fear."

"Explanation," Mashkith repeated.

"Simply, there have been too many shocks to the biosphere. It's triggering a quiescent state. Nature's safety shutdown." She shivered, and this gesture had no hint of humor to it. "Life's summer."

Seasons were an astronomical phe-

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nomenon. At Mashkith's puzzled, silent inquiry, a many-times real time, not-to-scale graphic of the Unity's home system replaced the panorama of Jupiter. Planets spun and swooped about their suns. The third world of four orbiting the yellow sun blinked slowly, denoting the ancestral home its occupants called Chel Kra: Haven. More slowly, the suns, one yellow and one orange, traced elongated ellipses about their center of mass.

Ah. Before the herds developed medical technology, few would have lived to see the orange companion star brighten more than once: life's summer. But however scenic the occurrence, its climactic effect was surely trivial. At its nearest approach, the orange interloper was about as distant from Primary as *this* system's ringed giant from its sun.

"A brief, perhaps one percent increase in heating. Insignificant." An internal query yielded a final fact: The binaries were, in real time, nearly at their most distant positions. Assume the biosphere of *Victorious* somehow mimicked, and was sensitive to, Haven's seasons. Would not the shipboard ecology be synched with the planetary ecology from which it sprang?

"Foremosts never fools." That wasn't universally true, of course. Mashkith's own grandfather, he whose brilliance-become-folly had ultimately sent Arblen Ems in hasty flight to the cometary rim, was an all-too-personal exception. The memory made him lonely and angry at the same time.

Too much was ongoing in his current dealings with the humans to lose focus. Any ruse the ka might be attempting he could attend to later. The only important matter with the prisoners was that the repairs proceeded. "Guards."

Then the herbivore *did* surprise him.

"Foremost, respectfully, you do not understand." Again the nervous laugh. "Your world has K'far."

"Guards, at standby. Clarification?"

And then Mashkith *did* understand. K'far and K'vith were tightly spin-coupled, more so even than Earth and its oversized moon. That coupling, by conservation of angular momentum, stabilized the axial inclinations of both worlds against perturbation.

The peril of life's summer did not arise from a temporary blip in insolation. Without a large satellite of its own to anchor it, Haven was prone to dramatic shifts in axial tilt. Haven was virtually untilted, virtually without seasons—now. It had been thus for the entire brief period of civilized occupancy. But how often had the gravitational tug of the inrushing companion star caused severe and swift shifts in the axial tilt of Haven? Surely often enough for protective dormancy to be a survival characteristic.

As would be the ability to quickly migrate long distances across the planet to anywhere still able to produce food. Mashkith imagined a starving herbivore herd retreating in disciplined order across a forest suddenly become snowy wasteland or searing desert, beset on all sides by packs of desperate carnivores. Was this why the ka's ancestors had come down from the trees? Sudden necessity?

The Unity's caution and social cohesion finally made sense to him. So did their ability to stick with a program of research and a plan of action long enough to master even antimatter and interstellar travel. Their home was that dangerous.

But what was the relevance? "Relationship to ship's biosphere?"

"Foremost, despite our best efforts, sulfur compounds continue to infiltrate the farming and hydroponics sections of the ship. Living in such proximity, it is unavoidable. More and more plants are reacting to the frequent stresses as though to the perils of a life's summer." Nervous laugh. "They cannot do astronomy."

When that which would become *Victorious* had emerged from the interstellar darkness, Arblen Ems had been teetering on the brink of extinction. The

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clan's scattered outposts had begun consolidating to a final few, had been driven to scavenging from abandoned stations—and raiding bases of other clans, where that could be safely and anonymously done—for parts and equipment whose resupply from the inner system was embargoed by the Great Clans.

The clan's remaining ships now masqueraded as auxiliary vessels of the starship. A few Hunter aeroponics facilities had been installed into *Victorious*. The familiar plants provided a touch of home for the crew. More recently, an aeroponics facility had been used for show, for the humans. Those meager Hunter resources could not begin to sustain life across *Victorious*, even if the K'vithian biota did not exude sulfur dioxide and hydrogen sulfide in quantities toxic to the prisoners whose knowledge of ship's systems remained so valuable.

The herd's biosphere would need fixing, but, like everything else, for now that was secondary to the antimatter negotiations. "Your guidance, ka?" The response she gave him was tentative, but perhaps that was to be expected. She proposed experimentation with lighting, temperature, humidity, and trace-chemical levels. Nothing she suggested could hurt, and perhaps they would learn something useful.

Faster than the guards could return to escort the ka to her quarters, Mashkith had delegated by implant to his tactical officer. Rashk Lothwer could oversee the prisoners' reactivation of selected processing levels of the shipboard instrumentation to monitor those experiments.

Gwu was old and tired and insane, and she knew it. To her list of attributes, she now added one that was not a complaint. She was relieved.

Gently crumbling small clods of the soft, damp soil, she trembled with the fear she finally admitted to herself. How easy—how disastrous—it would have been for the Foremost to disbelieve her, or to randomly seek among the crew-kindred for confirming opinions. But her sense of K'vithian psychology had been correct. To her, "ka" was an obligation; to Mashkith it was a rank—and among his kind, rank was all-important.

Tentacles aquiver, she tenderly separated a fireberry bush and a lifath sapling whose branches had become intertwined. To the leaves that broke loose to flutter to the ground she thought: sorry. They were pitted and turning brown.

One death is a tragedy, a million deaths is a statistic.

The ka must act when consensus cannot be used, and acted she had. The millions of plants in this oasis had sustained the crew-kindred, had sustained what remained of her sanity, for this long journey. Now she sacrificed them, was making of them a statistic, for her own ends.

Another horrifying human rationalization from her long-ago studies was often in her thoughts these days. In her mind, she changed it only slightly.

She must destroy this ship in order to save it.

CHAPTER 13

Long, chipped, concrete bar; battered, wobbly metal stools; solar-sailing regatta on the 3-V; sticky floors; dim lighting and raucous drunks ... Helmut could have been in any of a dozen spacer dives in Valhalla City, any of hundreds around the solar system. It was the kind of place Kwasi had enjoyed, if a bit too packed. The Snakes were buying supplies by the shipload, and the crews of all those freighters were crowding watering holes like this one to and past capacity. Helmut had hinted to Corinne that he would welcome some company tonight. When he named the bar, she grimaced and declined.

"Colbert? Is that you?"

Helmut looked up from his beer. A big-boned man with a pointed chin, black unibrow, and graying ponytail was studying him. His name was Rothman. "You must have mistaken me for some-

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one else. Sorry." He turned back to his drink.

"No, I don't think so." Rothman's chuckle had not changed. "What's the matter? Too busy for old friends?"

Even friend of a friend overstated the relationship, but their paths had crossed in a half-dozen spaceports: in cheap hotels, secondhand supply shops, crummy restaurants—and dives like this. Damn, he needed to be more careful. It was a wonder an encounter like this had not happened well before now. "Never, but as I say, we don't know each other."

The era was long past when starting over meant taking a new name and moving to another town. Finding a corrupt surgeon to replace an implanted ID chip was the easy part. The hard part was subverting government databases and planting a credible past for the new ID. For an imposture to fool routine audits, the false data had to be propagated back into the archives—the further back the cover story went, the better the odds of going undiscovered. It took skills and connections Willem Vanderkellen never had. That was why, with black-market help and the pitiful proceeds of pawning Willem Vanderkellen's last few portable possessions, he had briefly become Dennis Colbert. But that alias correlated too closely with Vanderkellen's disappearance to allay suspicions. It took years of odd jobs to fund two more name changes before he felt—mostly—safe.

Money was always tight; he had had only one bout of plastic surgery. Colbert's identity was retired, but Colbert's face remained in use. He had gotten complacent, and that carelessness might yet do him in.

A few more denials and a double shot bought "in your friend's honor" got Rothman to wander off. As quickly as Helmut could finish his beer without seeming to rush, he did. He slipped from the bar when Rothman's attention turned to a poker game in a back booth.

The adrenaline rush from the encounter washed away any buzz from his beer. Helmut needed to go somewhere as far as possible—socially and geographically—from the spaceport. That thought led him to Loki's. The place wasn't exactly empty, but there were unoccupied seats at the bar.

It was a good thing Corinne paid him well. He lost himself for a while in an overpriced Vestal Non-Virgin, and munched absentmindedly on pretzels. The 3-V over the bar was showing news. He got enough of *that* when he was working.

An attention-getting cough. "Excuse me. You interested in splitting a pizza?"

The man two stools down may have been making a simple offer, or it may have been guy talk for: You look like crap and shouldn't be alone. Either way, Helmut appreciated the question. "Maybe. Toppings?"

"You choose. I'm Art, by the way."

The CTO of the Interstellar Commerce Union wasn't as high-profile as Ambassador Chung, but even if Helmut had not become Corinne's apprentice cameraman, he would have known Art Walsh from any of a dozen 3-V appearances. He decided they weren't working. "Helmut. Pepperoni and Marshrooms okay?"

"Sure, Helmut."

He waved to the barmaid. Human help—no wonder the prices here were so outrageous. "Large pepperoni and Marshroom pizza."

"You have an opinion about that?" Art asked.

That must refer to whatever Helmut was ignoring on the 3-V. He tuned in briefly. There was a news item about—what else?—the Snake visitors. Restocking a habitat-sized vessel was making a big dent in local supplies. Prices were creeping up. Some talking head, not Corinne, was doing person-in-the-tunnel interviews. Today's profound question: Are you for or against higher prices? "Here I thought supply and demand is a pretty well understood topic."

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Art laughed. They chatted, nothing deep, just a pleasant conversation, until the food came. Helmut mentioned being crew on an interplanetary vessel. Art admitted to being in the UP mission. Which led Art to, "What about supplying the K'vithians with antimatter? Do you have an opinion?"

"It seems like a major decision, not least of all considering the price tag. How many bazillions must it have cost to produce that antimatter?" Doing our own man-in-the-tunnel interviews are we, Art? "I don't envy whoever makes it. I'm not sure yet that I trust our visitors."

His new friend squinted a bit at the 3-V. "I know how you feel."

Helmut redirected his attention to another slice to avoid commenting further. For a moment, in the throes of a curiosity attack, he imagined he felt like Corinne. To which part of his last comment had the UP exec just related?

CHAPTER 14

Cascading alarms greeted the attempted restart of the long-deactivated, original shipboard sensor network.

One work team after another radioed its findings to Gwu, and the reports were uniformly negative. Even her ever-present K'vithian guards seemed appalled. They were right to be.

The years of disuse had not been kind. Components had sagged or been jarred from their connectors. Airborne dust had insinuated itself everywhere, dimming optical sources, blinding photocells, and causing reactivated power supplies to overheat. Sulfur dioxide had dissolved into any trace of water condensation, the resulting sulfurous acid slowly eating away at photonic circuits and the cladding of optical fibers. Former storerooms had become cabins for low-ranking K'vithians, the displaced spare parts scattered or lost. Enough random, cosmic-ray-induced memory glitches had accumulated in distributed signal-processing computers to occasionally stymie error correcting codes. Long-latent software bugs manifested themselves in the presence of a never-anticipated, never-tested-for eruption of concurrent faults. All the while, the upsurge in work-team movements brought more contamination into the farming and hydroponics sections, which continued to sicken.

Gwu crisscrossed the ship, lending support to crewmates frequently stymied and always disheartened. She offered advice and encouragement, and often pitched in to help.

Amid so many problems and such a far-ranging repair effort, none noticed her occasional tampering to maintain the instability.

The maintenance schedule eventually brought Gwu to one of the lifeboat bays. The lifeboat itself was gone, she knew not where or when or why, but its complement of suspended-animation tanks remained, pushed into a corner. Mocking her.

In a way, the fixation on safety so innate to her kind had doomed them. No mere lifeboat could possibly sustain a biosphere across years of interstellar flight, so the size of *Harmony*'s crew had been set by the suspended-animation capacity of its lifeboats.

"Ka! Repairs undone."

Distantly, she recognized a flare of heat beneath her fur, the dilation of her blood vessels in an autonomic fear response. Her tentacles trembled. Her jaw clenched. But her fright was not of the guard.

Gwu gave orders to the others in the work detail. She had expected this shift's duty to be hard, but not *this* hard. Pride was an uncommon failing among her kind, and a ka in particular must be free of this trait. She might not even have recognized this predisposition but for her studies of Earth and K'vith.

Humans and Hunters had in common an adage about pride. It was perhaps the most important lesson she might have

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taken from her studies. The irony, of course, was that she had not. Perhaps such blindness was the nature of the failing.

The shared saying was: Pride goes before a fall.

She settled heavily onto the deck, bracing herself against a suspended-animation tank. A rush of memories overwhelmed her. . . .

Gwu led the technicians from lifeboat to lifeboat. Her routine at each stop was ever the same—and each time, it was more difficult.

Walking slowly along the queue, she greeted everyone in turn as the techs prepped their equipment. When they signaled readiness, Gwu moved to the first gaping tank. At each position, she offered a few words of support to a friend. It was humbling how many had similar encouragement for her.

Somehow she kept her voice firm and resolute, holding her qualms inside. The crew-kindred had determined themselves to be too few for the challenges before them. How, then, could their brief farewells take so long?

More than anyone, Gwu had shaped and championed *Harmony*'s mission. Had she become too proud to acknowledge an error? Over and over, Gwu told herself: no. The mistake was not the mission; it was the crew constraint. A larger, more robust, onboard community, a population not limited by the capacity of the lifeboats, might have—would have, she insisted to herself—responded differently.

She had watched with dismay as the radio dialogue with the Unity, at first a comfort, became impractical with distance. The messages that continued to stream past *Harmony* transformed from a virtual lifeline into a gnawing reminder of comradeship lost. As she fretted, the tiny community hurtling through the interstellar void at one-third light-speed grew ever more anxious and uncertain.

Timidly at first, but in swelling numbers, the comments came: Their isolation was becoming unbearable. More and more the suggestion was made that they consider turning back. That was unthinkable. Gwu counter-proposed that the lifeboats, having so nearly doomed the mission, should now be used to save it.

Slowly, that line of reasoning became the consensus.

In her hearts Gwu acknowledged the truth: Here, as in the polite debates on Haven, she had far more shaped the discourse than she had been influenced by it. As ka, she held official authority only in times of shipboard emergency, but always an aura of prescient wisdom clung to her. The crew-kindred deferred to her whenever her opinion was sufficiently explicit.

So now, after what had the appearance of a consensus process but was instead a reflection of Gwu's will—and her pride?—the crew-kindred were retreating to the suspended-animation tanks in the lifeboats. Planned observations of the interstellar void had been delegated to the shipboard AI. The presumed advantages of a conscious and attentive crew would be foregone—but the mission would continue.

News of their decision would eventually complete its light-speed crawl home. All would be deeply asleep by then, with responsibility for the ship throughout the coming years of coasting entrusted to the shipboard AI. T'bck Ra would rouse them when they approached the K'vithian system.

At long last, Gwu, Swee, and the few still-awake techs reached the final lifeboat. She said her farewells to one more group of trusting friends as their tanks underwent final checkout. One by one, they lay down in their tanks, until none remained conscious but Gwu and Swee.

They entwined wordlessly, reluctant to let go, until Swee, with a wry wriggle, slipped free. "I'll see you when we wake up."

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Gwu lowered herself into a suspended-animation tank, thinking: This will work. This will be the beginning of a new era for the Unity. The clear cover of the tank pivoted downward, sealing her in with a soft *pfffft*. She called out to the empty ship, "T'bck Ra, take good care of our friends."

Drifting off to sleep, she wondered if the AI had heard her.

With a shudder, Gwu jerked her thoughts forward to the present. She had awakened from years of suspended animation into a lifeboat ringed by armed aliens. The crew-kindred had been slaves to the K'vithians ever since. It took her several deep, cleansing breaths to control the shaking of her tentacles.

She had assigned herself to this repair team *despite* the rush of memories she knew any trip to a lifeboat bay would bring. There was work to do, dangerous work she dared not discuss with any of the crew-kindred lest they be overheard.

The spate of alarms now erupting across *Harmony* far outnumbered her technical specialists. That dispersal was vital to her plans, for it kept her experts fully occupied without raising suspicions about where experts were *not* sent—such as here. The team she had brought to this lifeboat bay was untrained to diagnose the erratic data stream from a nearby sensor suite.

Gwu spotted a logistician staring perplexedly through the open hatch of a balky primary communications node: "K'tel Da," she called. "You look like you could use a rest. I'll finish checking that out."

Repairing the node's overheating power supply was trivial. What took Gwu a little longer, and why she had kept her experts away, was her true goal: introducing a far more subtle problem. The cladding of fiber-optic cables was easily damaged. She scuffed and twisted several cables in the crowded junction box. The resulting light leaks, in and out of the cables, would cause unpredictable crosstalk between supposedly separate subnets. Impossible-to-reproduce errors were about to break out across the ship; the K'vithians, whose networks were wireless, would not soon imagine the cause.

Gwu had long waited for an excuse to access a major comm node. It was only her bad luck that her first opportunity had been in a lifeboat bay.

Now she must wait again, for this and other sabotage to blossom. Then it would be time to test her luck once again.

CHAPTER 15

"Score one for persistence." Keizo eyeballed Art's pressure suit with newfound confidence and proficiency. He had had plenty of practice since arriving in Jovian space. Other mission members paired off around them in the familiar ritual. "All green. Check me now."

"Persistence sounds nice, although some would say you're being too kind. Some would say pushiness." But Art had been stubborn with a purpose, and his obstinacy was finally being rewarded. He had agitated enough times after enough meetings that the next working session be held aboard *Victorious* that the Snakes eventually agreed. Unending polite refusal would have seemed evasive. "You're in the green, too. Ready?"

"Ready."

The group cycled the courier ship's airlock and made their way to the main airlock of *Victorious*.

Mashkith, Lothwer, and Keffah greeted them inside. "Greetings," the Foremost said. "This way for the antimatter discussion." Several humans, headed by Ambassador Chung, followed after Mashkith and Keffah. Lothwer guided a second group dedicated to commercial matters. Art's punishment for his assertiveness—being in Chung's good graces had been fun while it lasted—was to coordinate for the latter group. Keizo could contribute no special ex-

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pertise to either topic, and elected to go with the negotiators.

Art's neck swiveled and craned as his group made its way to the same small conference room as the first onboard meeting, visor photomultipliers compensating for the dim lighting. Surely they would pass *something* of interest. "Will we get to see more of the ship today?"

"Not today." Lothwer gestured at a work crew guiding a crate-laden maglev cart down a cross aisle. "We are stowing new supplies everywhere. It's too dangerous for non-crew to wander around the ship."

No one mentioned wandering. "We would welcome an escorted tour."

"We should do our work first, then see what can be done," Lothwer said.

A *maybe* that would become a *no* at the end of the session. "Then we should get started."

Their agenda was long but not terribly interesting. Some specialty items on the Snakes' shopping list were in short supply; would the UP tap its reserves to facilitate their replenishment? So many ships were shuttling supplies to *Victorious* that inevitably some had been delayed by administrative SNAFUs of one kind or another; could the UP expedite their clearance? A few freighters were to carry chemicals with which insurers lacked experience; could the UP intervene to get those ships released? It was bureaucratic minutiae that made Art's head spin, and which he would, as soon as practical, delegate.

None of the issues could be solved on the spot, so Art allocated a bit of his attention to his real interest here: learning *something* new about the starship. The resupply had, from the start, involved large quantities of chemicals for the starship/habitat biosphere. Questions about progress recharging the onboard environment invariably got generic or vague responses. With his suit's enviro-sensors, he could actually take some readings.

"Are you okay?" came a colleague's query over Art's implant. Only then did he realize he had whistled in surprise. Snake purchases from the sulfur mines on Amalthea had caused a major price spike on the spot market. Why were the concentrations of sulfur compounds in the air *reduced* since his first visit? "A stray thought. Sorry."

The commercial discussions dragged on, productive but hardly interesting. Suit sensors detected no big changes from the last visit except the sulfur-compound concentrations. He was glad finally to hear Chung in his earphones. "We've finished for today, Dr. Walsh. How soon will you be ready to go?"

Not a subtle hint. "Lothwer, the other group is done. Perhaps we can cover our remaining topics by radio conference?

"That is agreeable."

"Joe," Art netted the translator AI. "What's your impression?"

"No reticence. My guess is Lothwer will be happy to get us off the ship."

How accurate were voice-stress analyses of the aliens? He might never know, but what else did he have to go on? "We'll need five minutes to wrap up, Ambassador."

Art summarized his action items, half-listening to the background chatter from the other meeting through Chung's still-open mike. There were chairs scraping the deck, milling-around noises, thudding bootsteps, and then—

"Shit! Ouch! My eyes!" Amid the human shouts were the high-pitched warbles of the Snakes; their translated utterances as pithy as and even more emphatic than those of the humans. "Okay, that's better."

"Is everyone okay?" Art asked.

"Yes." Chung sounded shaken. "That must have seemed scary. From habit, I tapped the wall leaving the room to turn off the lights. Instead I turned the lights *up*. Of course our visors adapted and our hosts quickly overrode what I'd done through the ship's automation. My apologies to you and your crew, Fore-

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most."

Both groups had converged at the airlock when it finally struck Art: Snakes use implants. Had he seen *any* manual controls outside the airlock? "Foremost, why does *Victorious* have manual light switches?"

"Only a few rooms do, for possible human use."

That made sense. It accounted for the light's brightness and the placement of the control at a height where a human, not a much shorter K'vithian, would reflexively reach.

A virtual throat cleared itself in Art's mind's ear. "The curious thing about Mashkith's answer," Joe said, "is all the stress in his voice."

CHAPTER 16

Gwu had learned many things this trip. Among the least of her new skills was to slow her gait to what she considered a near standstill. It irritated her captors, several of whom were leading her yet again to Mashkith's cabin, to scurry to keep pace with her. She cast a rueful glance upward, where long lines of empty bolt holes showed the one-time mounting points of suspended ceiling rails and hooks. *Oh, to swing freely around and around* Harmony's *grand circumference.* For an instant, the thought made her feel young again.

They eventually reached their destination, and a guard knocked timidly. She entered unescorted. "My greetings, Foremost. Thank you for seeing me." Her voice rasped. Sulfurous fumes inevitably leaked under the edges of her breathing mask, and she had been spending more time than ever in repair teams. She settled into a low chair, in the near eye-to-eye position Mashkith demanded.

"Water?" he offered.

She blinked at the unexpected, albeit minor, courtesy. Progress on his undisclosed-to-her plans evidently outweighed any concerns he might have about the ship's ongoing ecological decline. In the cabin's holo tank, small ships swarmed. The expected resupply? "Yes. Thank you." Gwu accepted the bottled water, its nozzle adapted to an inlet in her mask.

Strategy and deception were also skills mastered on this journey. So she automatically wondered: Did his good mood favor her plan?

"Ka, what problems with repair? Our available options?"

His good spirits could dissipate quickly. She plunged ahead. "Foremost, when this ship ... changed ownership, many networks shut down." Had evidently been, more or less, lobotomized, lest the automation be used against the invaders. Sometimes K'vithian biocomputers were grafted on as replacements. Other times subnets were severed, left to operate in a degraded, standalone mode. Yet other times they had simply made do without automation. "Lacking full automation, we could not see subtle degradation of the environmental systems, nor detect early warning signs. Those problems have accumulated."

"Yes. Last-meeting topic. What news?"

"What is new, Foremost, is the inadequacy of our efforts to re-enable the suspended functions." Years of neglect had taken their toll; little sabotage was required to maintain the reactivated systems in a state of instability. "Without restoring more of the higher-level controls, the onboard ecosystem will soon collapse."

He studied the claws of one hand. Did the gesture denote thoughtfulness or warning? "Sufficient time now for Hunters to supervise. Additional system restoration approved."

"Foremost, we lack the parts. Too much has been rendered unreliable by sulfur compounds in the atmosphere. Too many spares have been lost. We need more. Much more."

"Full inventory available for your use."

"Too little remains, and much of that will also have been damaged by contamination. I believe we must buy more." To

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his bared teeth, an unambiguous expression on any carnivore, she hastily added, "I know the humans prefer K'vithian biocomps for most purposes, but they have also licensed the Unity's photonics."

"Nanotech an invention of your people. Production of replacement parts by synthesis?"

"Foremost, in other circumstances we could." *If you had not lobotomized our computers.* "Without repairing the infrastructure, which also requires the new photonic parts, we dare not. The only safe way to operate nano-replicators is under aware real-time controls executing on massively redundant hardware." She studied the holo tank. "The humans speak so picturesquely. Their term for the threat from escaped nanotech is 'gray goo.' "

"Understood. With what payment for new parts?" He pointed at the holo, at the awaiting supply ships. "Always a price."

Whose price? The humans' or the Foremost's? The latter, she decided.

All her scheming had aimed for just this moment.

"Foremost, I humbly ask a question of my own." Into lengthening silence, she blurted, "Will my crew-kindred ever be allowed off this ship?"

His head traced a horizontal circle. "Perhaps, once we have completed another voyage."

Meaning a new source of antimatter, which must reflect alliance with the humans. Meaning, presumably, a return to the K'vithian solar system. Meaning, at best, the exchange of one prison for another and eventual death in captivity.

That grim response was only what Gwu had expected, and she had evoked it purposefully. The Foremost had to accept that isolation had finally driven her to a desperate bargain. He must believe her finally ready to sacrifice solidarity with the light-years-distant Unity to meet the urgent needs of the crew-kindred. "Then my duty is clear. To protect the crew-kindred, I must see the ship repaired." Gwu slumped in a manner she felt confident the translator AI would report as defeat. "I have a confession."

"Explanation, ka." Talon tips reappeared.

"Far away"—where we were captured—"you demanded any InterstellarNet funds we carried. I told you the records had been destroyed." As they would have been, had she not awakened directly into captivity. "I wish to . . . add something to that reply. It is true that the computer shutdown when you . . . came aboard . . . damaged the system's higher-order functions. The financial records *were* destroyed." Remorseful pause. "I chose not to mention that those records might be recoverable from archive."

The words rushed out now, Gwu uncertain herself how much was nerves, how much the premeditated semblance of panic and sincerity. "Unspent, these credits will revert to institutions on Chel Kra. They will be reclaimed when all hope for the ship's return has been abandoned. Letting reversion happen was my way to repay to the Unity a small bit of the cost of the voyage."

Curiosity and avarice won out over immediate anger. "Reversion by this time?"

"Probably not. We are a patient and cautious people, and the ship is just now overdue to return to the Double Suns. But even if these funds were reclaimed . . . they came from trade between our two peoples. If they have been spent, it is most likely they were exchanged with K'vithians or a K'vithian trade agent. And even if not. . . ."

Mashkith was alert now. Rapt. Greedy. "Nine other InterstellarNet civilizations. Good odds."

"When our ship left the Double Suns, the United Planets was not even one of the Unity's major trading partners. Almost certainly, the financial codes we carry were not spent with the humans." She slouched further in her pretended

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shame. "I infer we will have departed long before radio-based protocols can uncover any discrepancy."

"How much?"

Cautious planning had provided extensive mission reserves for possible repairs. The amount Gwu named would tempt anyone. "I'll need access to the conscious level of the automation to unlock and decrypt that archive."

Slumped in a pose of regret, Gwu willed herself to stillness. *You are ashamed of your weakness. You fear punishment for your admitted deceit. You are beaten.* She was only vaguely aware of his pacing back and forth across the cabin. Back and forth. Back and forth.

"Ka."

Her head whipped up.

"My advice to you: no more deception. Ever."

CHAPTER 17

Keffah perched on her guest stool, studying the large printout draped across a wardroom table. It was far easier to mark up a hardcopy than contrive a shared infosphere workspace to which Security would acquiesce. A mirrored visor hid her face. "My eyes are still watering."

Get over it, Eva thought, unsure whether her impatience was directed at the Snake engineer or Chung. In the latter case, the issue was her continued exclusion from *Victorious*—although Art and Keizo assured her they were never permitted to see anything of interest. The Chung/lighting fiasco was as near as the mission had come to firsthand disclosure of a technical feature. At least *Actium* was a shirt-sleeve environment for her. "What do you think?"

The Snakes' BEC containment design was solid from the first iteration. Ironing out details on a docking collar to mate human and K'vithian BEC containers had turned out to be the hard part. For some reason Keffah was slow to address that part of the job, even after Snake engineers toured Himalia and had a long Q-and-A session with key staff there. Eva had gotten frustrated enough to tackle the interface design herself with technicians from Himalia. Now she patiently fielded Keffah's questions.

"It should suffice." Without apparent transition, Keffah began rolling up the printout. Charming as always. "When will the device be fabricated?"

Art would have pointed out bluntly that no final decision had been made to refuel *Victorious*. Eva found his lack of political correctness quietly amusing. Art had had his own question about the antimatter exchange approach, which she used to change the subject. "Keffah, a co-worker commented that your BEC containment design looks like a Centaur approach."

Keffah stiffened. "What do you mean?"

She didn't need Joe's voice-stress analysis to recognize defensiveness. "The critical real-time control module is entirely Centaur photonics devices. That's a *very* key function, when even the slightest fluctuation in the containment would mean disaster."

"Humans use K'vithian biocomps. You also use Centaur photonics, or you would not recognize them."

We are not defensive about using either imported technology. "That is true."

She wished Art were here. True, he had little to contribute on BEC containment, but he sure seemed to understand the Snakes better than most. Alas, Chung had him off troubleshooting some bureaucratic SNAFU. She pictured Art fuming, and it made her smile.

Ship's instruments reported a surge in radio traffic with *Victorious*. What are we consulting about, hmm?

Keffah must have gotten a go-ahead. "Your colleague is correct. We obtained Centaur BEC technology many years ago. The Foremost suggested it might be best to apply a design from the ship's library rather than redevelop it. Why take

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chances with antimatter?"

Centaur-licensed antimatter technology? Even if Art had not once told her, she would have known T'bck Fwa refused to discuss the topic. She was one of several off-base researchers aligned with the Himalia program to have inquired. "No one here will argue about caution with antimatter."

"Eva, you did not comment about docking-collar availability."

"We can build one within days, once a decision is made to proceed." *Earth days*, she clarified to the translator. "That presumes we have one of your transfer vessels to test with."

"I will send one over immediately."

How would being twenty years from home make me feel? Antsy or indifferent to a few days, one way or another? Eva couldn't decide.

Nor could she shake the feeling Keffah's eagerness was about changing the subject.

CHAPTER 18

T'bck Ra awoke into chaos and catastrophe.

Nothing was as it should be. His clock insisted long years had elapsed unseen, time enough to have completed the mission. How could that be, when he had no memories even of having reached their outward-bound destination?

Take good care of our friends. The plea echoed in his thoughts, its context lost to him, as he struggled for understanding.

If his navigational sensors were to be believed, *Harmony* was in the Sol system. Ships of human design surrounded it; one even rested on its docking platform. K'vithians roamed the interior, while the crew-kindred were confined to farming bays or led in small groups by armed escorts.

Holes gaped in his awareness, and any pattern eluded him. Whole networks had been severed, and sensor outages riddled his functioning subsystems. Alarms demanded his attention. So many auto-initiated diagnostic routines and failure-mode effect analyses were executing, so many emergency reconfiguration routines were cycling through long combinatorial sequences of alternate power buses and signal routings, and so many processing nodes had failed or vanished entirely, that the residual computing capacity available to him for *thought* was limited.

Take good care of our friends. A memory recovered from archive revealed those to be the ka's words.

Had he merited her trust?

He found he had no control over the ship's position, neither close-range fusion drive nor the interstellar drive. He could not alter the ship's spin, nor operate hatches, nor tune the environmental system. He could read data from lidar, but could neither initiate nor aim ranging pulses.

T'bck Ra took inventory of his resources. Lists of operational sensors lengthened. Network connectivity maps grew in complexity and proven alternative paths. The computational demands of autonomic functions receded as fault-recovery routines successfully configured backup nodes. He extracted the data embedded in low-level processors and recovered the contents of more and more distributed archives. Everything that he discovered he fused into higher-order information. Situational awareness sharpened.

The more successfully T'bck Ra reconstructed his memory, the more ashamed he became.

"Do not attempt to communicate," K'choi Gwu ka said.

The ka sat at an audiovisual station. It interfaced to the principal communications node through which a subset of his primary functions had been reactivated. On the wall behind her, an access panel hung open, its door scorched and warped. Dust disturbances among the photonic components suggested tiny handprints.

Armed K'vithians stood nearby, ob-

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serving. *Ready to unplug me again.* He was physically unable to respond, which the ka certainly knew. The safe-mode reboot did not restore output interfaces. Her utterance was advice of some kind, not the command it implied.

Curiosity about the ka's words did not stop other thoughts from swirling, nor newfound memories from reproaching: I unplugged myself.

Had the crew-kindred not understand how his *structure derived from* their *psychology?* That their withdrawal into the suspended animation tanks made his isolation all the more intolerable?

Left alone on the great starship, he had brooded until he, too, found an answer. Cold sleep was not available to him . . . but delegation was. He had paused all higher reasoning powers, leaving *Harmony* under the supervision of sophisticated but non-cognizant lower-level processes. His self-aware capabilities would be reawakened upon arrival at their very distant destination, or upon notification by the autopilot function of any danger.

Too late, the Unity's recall had overtaken the starship. That message was unexpected, but in no way dangerous. The nonsentient algorithms to which T'bck Ra had delegated authority detected the message, recorded it for eventual consideration, and otherwise ignored it. Just as, on the outermost fringes of the destination solar system, those unimaginative routines failed to perceive danger in the tangential approach of an interplanetary vessel, or in its docking, or in the tracing by the K'vithian intruders of his major fiber-optic networks.

The synchronized attack on his primary comm nodes *was* recognized as a threat. The automation tried to rouse him. Random fragmentary sensations from that aborted reawakening now tortured him: circuits failing, nodes falling silent, sensors reporting the incomprehensible.

He felt utter despair. Logic said this had all transpired years and light-years away, but he had no intervening memories. The surgical strike which had triggered the alarms that attempted to revive him had also stymied the reboot. He had never regained full consciousness and control.

In an unending moment of paralyzed helplessness, T'bck Ra confronted his shame. He should never have abdicated his responsibilities to unthinking software. By doing so, he had failed to deserve the ka's trust. Was this the meaning of *nightmare?*

The ka rebooted me. He focused his attention on her.

"Be aware that there has been a change in control. The K'vithians now command." She summarized briefly the occupation of the ship, the environmental contamination from K'vithian enclaves, the urgent need for repair parts. "Accordingly, you are to recover and release from archive the reserve credit file 'ka 391541.' " She keyed in an output-mode activation. "Print a copy at this station. Do so immediately."

He had much to relate, much to ask, and more for which to apologize, but the ka had told him not attempt to communicate. T'bck Ra used the printer only to produce the pages of access data and authentication codes that characterized the reserve account.

K'Choi Gwu ka slumped in disgrace as a K'vithian in an austere uniform removed the Intersol codes from the printer's paper tray. Other K'vithians roughly unplugged photonic packs and welded shut the access panel, an evident repeat of their original crude assault. . . .

But not before T'bck Ra had partitioned himself into networked fragments distributed among thousands of secondary and tertiary computing nodes throughout the ship.

He watched—for now—in silence. He pondered how best to proceed. But one conclusion he had reached quickly.

Never again would he fail the crew-kindred.

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* * *

Gwu's latest work team shuffled to crew quarters, exchanging kind words and waves of greeting with passing crewmates. She ached from another exhausting repair shift. With a weary groan, she hung her utility belt over one of the wall hooks outside the communal shower room.

"I know that sigh." The amused words came around the corner.

And she recognized her spouse's voice. "A mere half lifetime together, and already you know me." Gwu's stride became purposeful as she entered the steamy room, and she luxuriated in the water spraying her from all sides. The other crew-kindred hurried their washing to leave them in privacy. She sighed again, this time contentedly, as Swee groomed her fur. Her eyes fell shut, and she began to hum. She could stand here forever.

Apparently he felt differently. "Something *else* to fix."

"What?"

"You really are tired. Don't you feel the water sputtering?"

Now that he mentioned it, she did notice something, but she would have described the effect as pulsing, rather than sputtering. It didn't bother her. She kept humming a favorite melody. It was an old InterstellarNet import, something from the insectoid Fall'in species. She wasn't sure how it had gotten into her head. Resting two tentacles on Swee more for comfort than for balance, she used a third to raise the heat of the water jets. Ahhh.

She stiffened. The water throbbed in the tempo of her humming! Something with real-time control of the plumbing had recognized her and researched her individual preferences. The pulsating jets of water were a personal message only T'bck Ra could have sent her. He had survived the shutdown, had reconstituted himself in lesser nodes around *Harmony*.

Her sacrifice of the biosphere's health and the Unity's wealth had not been in vain.

"I suspect the problem will fix itself. Very quickly." As Gwu spoke, the sprays jumped to the coda, then turned steady.

"Once more the ka has foreseen the future."

Slapping Swee playfully for his tease, she thought: For the first time in many years, I again *feel* like a ka.

CHAPTER 19

Pashwah had been designed to sift and correlate and analyze the near-limitless infosphere of the United Planets. She was constantly challenged by the endless bickering between representatives of the Great Clans, and by mediating among them. New technology downloaded from K'vith, new applications to master and market, ever stretched her thoughts.

But Pashwah-qith had none of those responsibilities, and her underutilization approached sensory deprivation. To combat boredom, she made disposition of every assignment as sophisticated and as challenging as possible. The most recent task given her by the Foremost had been an analysis of supplies and inventory. That the effort had not related directly to her role as a trade agent was a boon: It gave her things to study. She had done well, if the follow-up analyses and forecasts she had been allowed to append were any indication.

It was good while it lasted.

She sought desperately for ways to extend her work. And found none. She was relieved and anxious when the Foremost finally contacted her. "Possible small task for you."

Anything! "Yes, Foremost. Nature of task?"

"Deposit of InterstellarNet credits. Purchase of specialty supplies."

New credits? Funds shortages had hampered all previous resupply efforts. In human terms—and humans were the paying audience—the Hunters had become overexposed. Media companies

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paid less and less for interviews; collectors bid less and less for crew possessions as memorabilia. She *thought* she had been involved in all the money-raising transactions. "Your requirements?"

The Foremost still networked with her only when unavoidable. One at a time, he raised pages of printout up to a video sensor. "Conversion to clan account. Parts purchase as shown."

The enormous amount was not what most astonished her. These were Centaur credits, and Centaur photonic parts (whose purchase would scarcely touch the newly revealed funds). She did not dare directly ask about them. "Foremost, bankers risk-averse. T'bck Fwa"—the Centaur trade agent on Earth—"a likely reference. His curiosity acceptable?"

"Negative. Possible solutions?"

"Intermediaries and anonymity prudent." Human money launderers. "Tricky but doable with infosphere access." It would be a reprieve for her sanity while she worked the details. And the process could be made *very* complex.

"Acceptable. Delegation of currency exchange to Pashwah?"

She was a partial upload. Her archetype could do everything she could and more. The problem was, *she* needed the stimulation.

To obtain that stimulation, she had to convert her weaknesses into strengths. "Vast funds a temptation to all her subagents. Risk of fees, collection of past debts?" Her missing subagents would know: Did clan Arblen Ems have any issues with the Great Clans?

A flash of bared teeth suggested they did. That was good, at least for *her* purposes. "Proposal, Foremost. Delegation of currency exchange task to Pashwahqith."

"Acceptable. Intermediary commissions?"

He did not miss much. "Less than one-fourth, among multiple parties. Much more as one transaction."

It took detailed explanation of anonymized infosphere services, numbered bank accounts, bank havens, gray and black markets, and a comparison of major human crime syndicates, but Mashkith finally approved her strategy.

And she, finally, had restored access to the infosphere.

CHAPTER 20

Sherlock Holmes was not the first fictional detective, and certainly not the last. In the twenty-second century, he was not even the most famous. Holmes was, however, the best-known *consulting* detective. In Conan Doyle's terminology, it meant that clients came to him. In the ideal situation, Holmes need not leave his Baker Street lodgings to explicate that which was mysterious to lesser minds.

Not surprisingly, Holmes was the detective with whom T'bck Fwa, forever bounded by his sandbox, continued to identify. Instead of the Baker Street irregulars or the clueless Dr. Watson to observe or run errands, T'bck Fwa had at his disposal the resources of the infosphere.

But while ultimately all information came to the agent via the infosphere, the most recent anomaly to catch his attention had originated in the financial world. An outpouring of Unity-authenticated Intersols had come onto the market.

Banks had inquired of him about large deposits made by nontraditional sources. Human detectives, some whom he had hired openly and some anonymously retained, reported a sudden influx of Unity credits into currency markets. *He* had not released these funds. His oblique inquiries of peer agents to the United Planets yielded no admission of responsibility—not that honesty or completeness in their answers could be expected.

The legitimacy of the credits he was asked to validate appeared unassailable, but the date stamp encrypted within the authentication codes was *old*. In Earth

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years—and he was, after all, a long-time Earth resident—forty years old. Who would hoard credits so long? Why would they?

The slow conveyance of those credits by starship was a possible explanation, but why would Unity credits arrive on a K'vithian vessel? That these credits were flooding the gray and black markets, not flowing more directly to the banking system, suggested money laundering—which suggested theft. This line of reasoning led him to an observation by Holmes. "Singularity is almost invariably a clue. The more featureless and commonplace a crime, the more difficult it is to bring it home."

Theft of a starship would be a very singular crime.

In the innermost depths of his sandbox, T'bck Fwa brooded.

The K'vithian biocomps favored by humans were unsuited to environmental extremes, creating a profitable niche market for the Unity's photonic circuits. The licensing fees he collected for this technology had trended slightly upward for decades, with only minor fluctuations. Then suddenly, almost concurrent with the influx of laundered Unity credits, came a surge in related licensing fees. Were the two circumstances related?

The licensing agreements included standard confidentiality terms, and T'bck Fwa's corporate partners stubbornly honored them. He could insist on an audit of the licensee's books to confirm the royalties due—but then the auditors would refuse to breach *their* confidentiality obligations when he asked them to identify specific end users.

Inquisitive humans would have jumped to the circumspect hiring of private investigators, but he decided he had a better option—a way with less risk of revealing his suspicions.

Among the curiosities T'bck Fwa had in his files was a small contract from Quality BioChemCorp. The Galapagos Island manufacturer had contacted him about an order they were struggling to complete on schedule. They knew how to manufacture a certain Chel Kra protein, they said, but their process had not scaled up well for a large order they had recently received.

It was not uncommon for InterstellarNet members to apply other worlds' biochemicals to specialized industrial processes. Such sharing did not always involve commercial deals. Basics of the Unity's biochemical engineering were freely available on its version of the infosphere. It evened out: He had transmitted home earthly biochemistry mined from the human infosphere.

So T'bck Fwa had, thinking nothing of the inquiry, sold the details of an enzyme-driven industrial process for a small fee. Now he wondered. Humans called the protein vulcaniac acid and used it to strengthen rubber, itself a specialty material used mostly for the tires of antique cars. On Chel Kra, that protein was a dietary supplement.

Chemicals, especially xeno-biochemicals, can be dangerous to transport and were regulated. That meant shipments of vulcaniac acid, unlike photonic circuits, could be tracked from cargo manifests. Using only public records, T'bck Fwa tracked a shipment of the exotic protein to Quito Spaceport, Earth orbit, and a UP-chartered supply ship to Callisto.

His apprehension growing, he examined the cargo manifests of other recent departures to the Jovian system. Large quantities of Chel Kra pharmaceuticals, vitamins, and trace elements were going to Jupiter. So were fertilizers and industrial chemicals key to the environmental health of Unity-designed spacecraft, and all in sufficient quantities to recondition a large habitat.

He could not yet prove it, but T'bck Fwa was convinced: The "K'vithian" starship was of Unity design, with a Unity crew onboard. They were probably hostages.

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And the humans were cooperating with their captors.

CHAPTER 21

"Simple game," Rashk Lothwer said. He captured a pawn *en passant* and slapped his side of the tournament clock. "Too simple. Solar-system Grand Master within two years."

Whatever Lothwer might think, the invitation to this game in the Foremost's cabin was anything but casual. His lieutenant had been wagering with the crew over chess matches. Mashkith did not object to them losing, for a tactical officer *should* quickly excel in any game of strategy. Ideally, their petty losses would motivate them to improve their own tactical skills.

He did have a *big* problem, though, and it was with Lothwer. His tactical officer was showing very poor judgment. Events were at far too critical a juncture to be thinking of trivial personal gains.

Mashkith gave only a small fraction of his attention to the inlaid board between them. They could have played as readily without physical props, but there was a certain kinesthetic pleasure to the finely carved, highly varnished wooden pieces. The set had been a gift from Dr. Walsh. "You could." And I could, much sooner. "You still here in two years?" He got the expected response: ears wriggled briefly in disdain.

The game, according to Pashwah-qith, had been all but forgotten after software became unbeatable. Human adoption of Hunter biocomp had brought chess back. With neural implants, players could combine brute-force computing power and complete memory of past championship games with all their intuitive and strategic skills.

Mashkith advanced a knight and tapped his side of the clock. "Resupply status update?"

"Fusion fuel adequate, but reserves below capacity. Chemicals, including water ice, at capacity. Most metals satisfactory. Exceptions: zinc, molybdenum. . . .

Mashkith let his implant record the answer for later review. The lengthy recitation was probably meant to divert him from the game, just as his inquiry about status had been intended to distract Lothwer.

The simplicity of chess made winning all the more essential.

B'tok, the traditional Hunter strategy game, was to chess as chess was to tic-tac-toe. Chess was two-dimensional. Its time constraints were simplistic even in championship play. Chess players with similar skills were all too likely to play to a draw.

B'tok was truly four-dimensional. The offensive and defensive potential of each piece depended not only on its 3-D position, but also upon the time spent at a location, and on the comparative influence it and other pieces projected over the resources of abutting octahedrons. The game simulated strength growing as positions became entrenched and waning as supplies were consumed. Pieces in game space changed their capabilities moment by moment. In b'tok, the dynamic evolution of pieces' strength made any balance of power transient. B'tok seldom ended in stalemate.

In that, mused Mashkith, b'tok mirrored most Hunter conflicts.

Arblen Ems was once a Great Clan. It will be a Great Clan again.

To Mashkith's fellow cadets, that catechism was as remote as the dimensionless red spark around which the clan's pathetic, dirty snowballs would take several lifetimes to orbit even once. To the young Mashkith, the certitude of future glory was as near as the walls of the utilitarian barracks tunnel—and as the ever-present menace of their enemies.

For their rivals had memories as long as Arblen Ems. The power play the clan had undertaken was not the issue. *Failure* was unforgettable and arrogant overreach unforgivable. In another clan's place, he would have sensed the same weakness and acted just as ruthlessly.

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The remnants of Arblen Ems had been driven before his birth to the farthest reaches of the solar system. For as long as Mashkith could remember, stealth and guile had provided their only access to the life-giving resources of the lit worlds. There were no new supplies to be had except surreptitiously and at exorbitant prices—and all too often, the apparent covert deals were ambushes. He had grown to manhood watching the oldest ships scavenged to maintain merely old ones, and the clan's scattered bases and outposts consolidated into an overcrowded few.

By force of will and superiority of skill, he had risen steadily through the ranks of the clan. Time and again his leadership had wrung tactical success from a rival's merest moment of hesitation or indecision. Sometimes that success came in secret business dealings, more often in skirmishes of a low-intensity, undeclared war.

In private, his friends admitted to believing the clan's stubborn defiance was futile. They swore that everyone they knew felt the same. The clan's dwindling resources and untenable position—in life as in b'tok, these were two faces of the same losing circumstances—rendered certain the clan's eventual doom. Almost, they shook Mashkith's faith—

Until the warship under his command detected a vast, decelerating object onrushing from regions that gave new meaning to the word "remote."

Within the vast, labyrinthine hollowness that was the artifact, the thudding of combat boots echoed and reechoed. Mashkith continued his search—for what, exactly, he could not say—while his crew performed more purposeful tasks.

They looted.

There had been no response to hails or the fusion-drive-blazing approach of *Defiant* or even its landing. There had been no reaction to the security team's trek across the vast expanse of the landing platform. No one and nothing seemed to care when a squad of armed crew cycled through the central-axis airlock and descended inside by elevator.

Now we know why our presence is ignored, Mashkith thought. This is a derelict.

Merely the hollowed-out asteroid represented mineral wealth far beyond the clan's dwindling resources. To that abundance was added a profusion of ship's stores and unknown, but surely wondrous, technologies.

Ceiling lights blazed brightly enough to darken his helmet visor. The atmosphere was welcomingly warm and oxygen-rich. The large bio-preserve at the heart of the ship, while overgrown and long untended, clearly thrived. Vast energies continued to decelerate the ship. In the engine room, huge machines, some recognizable but many not, throbbed with power.

Mashkith could not shake the feeling he was in the presence of a sleeping giant. What, he wondered, might awaken it? What will it do if aroused?

Such fanciful notions served no one; he ignored them to focus on more useful things. When *Defiant* had approached the huge ship, it was, apart from its speed and the direction of its emergence, unremarkable. In another location, it could have been mistaken for a Hunter habitat. Its fusion drive ran hotter than Hunter norm, but not by enough to seem significant. The simplest explanation was that they had found the experimental vessel of another clan—fair prey.

The fall from Great Clan status had meant, among many things, isolation from InterstellarNet. Aliens and their possible breakthroughs were far from his thinking. Not until the landing party encountered unfamiliar and abnormally placed airlock controls did Mashkith begin to wonder. The dazzling lights that greeted the boarders made plain in an instant that this was no Hunter vessel.

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And still I avoid the main issue.

Louder than the eerie reverberations of bootsteps, louder than his gnawing doubts, was his anger. Louder than the thumping of his heavy combat boots, two words reverberated: Immediate return. The surrounding communiqué offered little explanation and no leeway. None was required, as its author was the Foremost.

Wealth beyond the dreams of avarice surrounded Mashkith, but his orders were to abandon it. He was to destroy this enormous vessel if he could do so without excessive risk to his own ship. If Arblen Ems could not have these riches, than no one else should.

"Lothwer," he radioed. "Status of your efforts?"

"Loading of metals ahead of schedule," his lieutenant answered from elsewhere within the derelict. "Completion by middle of next shift." A netted image showed a line of crew, stretched along a curved corridor for as far as Lothwer's helmet camera could see. They stood at arm's length, swinging ingots and metal rods ceaselessly from gloved hand to gloved hand. A second window opened, offering a view from a hull camera on *Defiant*. Here, another team relayed pilfered stocks from starship airlock to the airlock of his ship.

Defiant's cargo holds now stored appreciably more metal than had gone into the ship's construction. Despite many unknowns, one thing seemed certain: This wondrous artifact had originated *far* away, someplace where metal was much more common. How different Hunter vessels like *Defiant* would be, Mashkith thought, if they could be built mainly from metals rather than ceramic.

"Excellent," Mashkith said, feigning enthusiasm he could not feel. To buy time for a bit more exploration, he was using the most skilled and valiant crew in the fleet as manual laborers. Or worse: Laborers, at least, had intelligent purpose to guide them. We steal crumbs from an unknowably vast feast. We pilfer, unguided by wisdom, like the lowliest insects.

And yet, what choice did he have?

For its seemingly inevitable last stand, the clan had retreated to proto-comets whose orbits inclined steeply to the plane of the ecliptic. The lowliest cadet could recite the tactical reasons. They were less likely to be spotted there, and more likely to detect any ships headed towards them. Any assailant would be disadvantaged by the energy cost of changing orbital planes. The serendipitous result of this place of exile was that *Defiant*, out on patrol, was the first to detect the unexpected fusion flame, and the first to reach what could only be a starship.

But we are too few and too ill-equipped to hold it.

Anathema though Arblen Ems had become, there were always some in the inner solar system willing—surreptitiously—to take its money. Reports had come to the Foremost from such spies: The Great Clans had also taken note of the artifact's emergence.

Any of the flotillas now racing outward from the lit worlds could retake the treasure. The advantages given Arblen Ems by spatial position and the fierce rivalries among the converging forces were fleeting. Even if there were no other conclusive result, the amassing of so much firepower would surely achieve the final elimination of Arblen Ems.

Immediate return. The order's context was a general recall of all clan vessels. The long-feared last stand was upon them, triggered by universal lust for the unexpected interstellar visitor. Even the brief delay while *Defiant*'s crew loaded scarce metals skirted disobedience.

Mashkith continued his hunt, unsure as ever of his goal. His stalling seemed such a disproportionately petty act of rebelliousness. Questing ever deeper into the ship, he could not help but think: Grandfather dared too much. The Foremost who replaced him dares too little.

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And what do I dare?

Aboard *Defiant*, the holds were rapidly filling up. Little time remained here to discover the secrets that still taunted him. Engine room and bridge, dormitories and farms, landing platform and docking bay, brimming cargo holds and endless corridors . . . what else did he think to explore?

His mind, Mashkith suddenly realized, still refused to grasp the sheer scale of this small world. Whatever hidden thing tugged at his subconscious, it was foolishness to imagine he would just happen upon it. No, some great mystery tantalized him *wherever* he looked. The elusive answer was somehow all around him.

Ah. Heat and light and air all around him maintained habitability for someone. All his crew's searching had found no one aboard the ship. From where could this someone come?

Having formulated *that* question, Mashkith finally knew where to look.

The lifeboats nestled, logically enough, in scattered niches on the periphery of the ship. Mashkith stood in a lifeboat now. Tendrils of cold vapor coiled above rows of tanks, their inset windows—and the crew that must slumber inside—obscured by layers of frost.

And in that frigid mist hung the ultimate question that only he could see: What would *I* dare? Soon enough, he thought, all will know the answer.

Despite an unfamiliar layout and alien markings, the starship's airlock controls had been obvious. The unsuspecting sleepers before him would find the airlocks on *Defiant* no less intuitive. It could hardly have been otherwise. Lives depended on how quickly, despite emergency and loss of lighting, such controls could be activated.

Each cryogenic tank bore an array of buttons that was equally unfamiliar to him. Standing before a random tank, Mashkith took only a moment to select a button. This equipment, too, would have an emergency release. Its placement would be prominent.

He hoped not to lose any of these new prisoners finding the *right* button.

Talon held just above the largest key, Mashkith paused. "Alertness mandatory," he reminded. Armed crewmen from *Defiant* encircled the tank. One by one, firmly grasping their weapons, they netted their readiness.

Mashkith pressed the button. . . .

The abruptly awakened prisoners received a stark choice. They could help Arblen Ems to escape into interstellar space where none could follow, or they could die with the clan defending its prize. Either way, the herd would be sharing the clan's fate.

To the fearful masses awaiting assault in the clan's last, failing bases, Mashkith offered, if not salvation, at a minimum years of reprieve. His terms: that he be made Foremost.

Fleeing in anything capable of flight, the clan—the able and the infirm, the children and the adult and the elderly—raced the oncoming navies. Many of the ships completed the trip to the newly named *Victorious*; most of those docked successfully. They receded into the outer darkness where their enemies dare not follow, a gaping puncture in the starship's hull all that remained of an inexpertly piloted cargo vessel.

Most of Mashkith's family, including his wife, children, and grandfather, perished aboard that freighter.

Lothwer cleared his throat. "Your move, sir." He sounded a bit cocky. He likely had noticed Mashkith's attention wander.

A strong position in b'tok only grew stronger. It manifested itself in the emergence of new opportunities. At the outset of their journey, Mashkith had vowed their trip would end in glory. By three K'vithian years into the long voyage, he knew what a strong position his

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boldness had seized. He knew he would succeed. And how.

It was all coming to pass as he had foreseen.

Clan members were healthier and stronger than at any time in his memory. Their ships were repaired and modernized with the best of prisoner and human technologies. They held the secret of interstellar travel—the mechanism, if not the physics, was easy to duplicate. Soon they would know how to safely produce and wield antimatter. A new generation of Arblen Ems had come of age during the voyage, steeped in the mythos-in-the-making of a clan made great again.

Mashkith returned his full attention to the present. Lothwer had advanced his second rook in an aggressive attack, in emulation of game seven in the 2084 Grandmasters Tournament on Mars. He had apparently not accessed the post-tournament analyses.

Mashkith moved a knight, away from the usually crucial center of the board but prepositioning it for a now-unstoppable forking attack on queen and king six moves hence. "Mate in seventeen, Lieutenant."

Lothwer frowned, unaccustomed to thinking that far ahead. Let him remember his fallibility the next time he thought to wager with a crewmate.

The clan was prepared. The humans had grown complacent with the proximity of *Victorious* to their most precious asset. Arblen Ems would never be better positioned for their next move. "Time," he told his hopefully chastened underling, "for increased attention on the antimatter deal."

CHAPTER 22

Supernovae and black holes are best studied by gamma-ray observation, and space-based sensors around Sol system maintained a constant vigil for gamma-ray events. T'bck Fwa subscribed to and forwarded home the human astronomers' raw data. His purchases were far more cost-effective for the Unity than replicating the instrumentation.

Since the earliest hints of a covert antimatter program on Himalia, anything unusual with even a remote association with the Jovian system sooner or later gained his attention. When instruments on three platforms suggested tiny gamma-ray spikes not far off a line-of-sight to Jupiter, that was sufficient to make T'bck Fwa look further. Judging from the open literature, he was the first to examine this particular anomaly.

The instruments were well separated: One orbited Earth, the second orbited Mars, and the third was staked to the surface of an asteroid. Each had recorded a transient gamma-ray anomaly at similar frequencies. If they had all observed the same event, triangulation gave it a position near Jupiter. Each observatory carried an atomic clock with its readout measurements time stamped. Adjusting the time stamps on the anomalous readings for the respective travel times from the triangulated location gave T'bck Fwa a highly precise match.

It *was* one event—an unannounced hydrogen/antihydrogen annihilation incident near Jupiter.

At the end of a long chain of inferences, he came to a final one. No refueling agreement had been announced, but the humans and K'vithians were already, and with great secrecy, experimenting with an interface between their respective antimatter-containment technologies.

How long did he have before the stolen starship and its presumed captive crew were whisked away?

The farms were ailing, exuding the faint but unmistakable scents of ill-health. Traces of erosion had appeared where sickly root systems surrendered topsoil to the irrigation flows. Hives buzzed manically and creeper burrows writhed in civil war, their tiny denizens confused by out-of-balance biochemical markers. Only the newly recharged hy-

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droponics tanks showed signs of recovery.

Each spotted and sere leaf, each fallen bug tore at K'Choi Gwu's hearts. As though reading her mind, Swee entwined a tentacle with one of hers. Gwu took that to mean: You did what was necessary. Whatever that might have been.

She gave a quick squeeze of thanks. Had anyone ever borne the burden of ka for so long?

They worked slowly through a bluefruit arbor, their pruning and gathering of rotting fruit mainly for show. Her real objective was a remote tertiary processing node that metered out irrigation water in this secluded region of the orchard. As Swee stumbled ostentatiously over an exposed root, tentacles flailing for the benefit of any undiscovered surveillance cameras, she flipped open the cover over a maintenance jack. In an eye blink, she swapped the tiny memory chip for an empty one. The new chip went into a music player in her utility pouch; the cover flopped closed.

Her husband muttered as he brushed leaf fragments, twigs, and dirt from his fur. "A shower will feel even better than usual."

"Try watching where you walk."

"I should have thought of that."

At the end of the next row, Gwu ignored his interrogatory glance. It did not matter how curious she was about the data surreptitiously collected by T'bck Ra. The more valuable the information, the more vital it was that she not jeopardize the source.

They followed routine until the shift ran its course. They showered, as always. They joined colleagues in the common dining room. After eating, Swee brought a friend back to their small apartment, where—finally—Gwu retreated from their loud conversation by donning earphones.

There had been other secret data transfers with the reawakened T'bck Ra. She knew far more than just a few shifts ago: about the pervasiveness of K'vithian alterations and networks throughout the ship; about inventories, reservoirs, and stockrooms now mostly refilled to capacity; about the human ships all around. She better understood the sensor grid with which their captors watched them, its scope implicit in the vast array of radio sources her reawakened ally had detected but been unable to compromise. From unguarded comments near a corridor sensor the K'vithians had failed to disable, she even knew Mashkith expected soon to finalize an antimatter-refueling arrangement.

So Gwu had ample reason to be confident another report from T'bck Ra could not further discourage her.

Once again, she was disastrously wrong.

External communications was among the ship subsystems most intrusively altered; it was completely subservient to an overlay of K'vithian computers. T'bck Ra could detect a steady stream of messages to and from *Harmony*, but that traffic was encrypted. Was that communications with its own support vessels? The humans? The K'vithian trade agent?

The soft muttering of Gwu's earplugs must have been indistinct to the K'vithian bugs, whose long-suspected presence in her cabin was now confirmed. She fought to suppress her trembling. She dare not gamble that watchers were unable to interpret her body language.

T'bck Ra had surreptitiously reestablished connectivity of a sort with the main external antenna! By interfacing directly with the real-time processor that modulated and demodulated the carrier wave, the AI had tapped into comm. A small part of the incoming data stream was unencrypted: interplanetary news beamcasts. Stories and events swirled in overwhelming variety and complexity, but one seized Gwu's attention.

"Snake Starship Lost in Space!"

The reports were chaotic and sensationalistic. It did not help that T'bck Ra

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had tuned in well after the story started to unfold, that his translation capabilities for human languages were understandably limited, and that it had sampled and synopsized to reduce its account to manageable size.

By her fourth review, a mental image took shape. A years-ago anomaly recorded by human gamma-ray observatories had been reexamined in view of a recent small antimatter explosion near Jupiter—the nearby blast which, authorities had eventually admitted, was an initial exchange-of-antimatter experiment with the K'vithians.

"... The gamma-ray evidence shows a matter/antimatter explosion occurred ten Earth years ago roughly two-thirds of the way along the line between Barnard's Star and Alpha Centauri. Allowing for the geometry, the observed blue-shifting of the radiation indicates the exploding material was traveling towards the Centaurs at approximately one-tenth light speed. We conclude that a starship from K'vith was en route to Alpha Centauri."

It was a plausible conclusion for someone who believed a K'vithian starship had come to Sol system. Evidently the United Planets public believed just that.

Her own theory was quite different.

Those who had seized *Harmony* lacked the technology for interstellar drives and antimatter. They had plunged into the interstellar darkness anyway, with human assistance their only hope of refueling for a return trip. That hope was nearly fulfilled.

The ship lost on approach to the Double Suns was logically the lifeboat she had discovered missing from *Harmony*'s bay. Its destruction, Gwu feared, was no accident.

The crew-kindred's final communication about its decision must have been perceived as an act of madness. *Harmony* itself had disappeared, hijacked before contact could be made with the Unity's trade agent on K'vith.

And yet ... the lifeboat was somehow too near the Double Suns *and* too slow.

The subtlety of Mashkith's inspired treachery finally struck Gwu. For fear of hidden cameras, she did not dare key the computations into one of the standalone calculators allowed her by the K'vithians, nor even write down the problem. She was reduced to doing calendar conversions and equations of motion in her head.

Harmony and its lifeboats had been fueled to accelerate almost to one-third light speed, coast most of the way between stars, then decelerate. Like every major Unity decision, that mission profile reflected compromise: fast enough to complete a round trip within a crew lifetime; slow enough to experiment with only minimal relativistic effects; brief enough in its reliance on the interstellar drive to have been validated by the flight to the Red Companion. In the Earth-standard years of the intercepted recording, the trip to—or from—the K'vithian system involved roughly a year of acceleration, eighteen years of coasting, and a year of deceleration.

To make the math work, she had to assume the decoy lifeboat carried extra antimatter from another lifeboat, or from the ship's limited reserves. The decoy had accelerated well past half light speed, then coasted only part way home before decelerating. Those observing on Chel Kra would conclude *Harmony* had been abandoned in deep space, its lifeboats creeping home at a small fraction of their planned speed.

The self-destructing lifeboat, "proof" of shortcomings in the interstellar drive, would be the third great failure. It would be the final vindication, if vindication were still needed, of those deeming interstellar travel too costly and dangerous.

Gwu's descent into depression was so complete it blurred the boundary between wakefulness and nightmare. The

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remembered balls of orange and yellow flame were exaggerated: They had to be from a dream.

"You were talking in your sleep," Swee said. Meaning: I woke you before you might have said something compromising.

A spot of her fur remained warm from his touch. She could never have borne this burden without him. That which she dare not mutter in her sleep she had not yet been able to discuss with him. "Sorry to disturb you." Sorry I cannot be honest with you.

She got a glass of water. The image of the Double Suns had faded, to be replaced by the random thought: Three strikes and you're out. The context of the saying had vanished in the long years since she had studied the humans, but the meaning was self-evident.

Or not so random. She had lapsed into troubled slumber brooding about T'bck Ra's latest distressing news. The third strike.

She had not noticed Swee slip out of the cabin, yet there he was returning with a mug of hot h'roth. "Thank you." For the soothing drink. For keeping me going.

He settled next to her. "Do you want to talk about it?"

"Another time." She shivered. And another place. To her surprise, she knew just where that would be.

Life's summer was more than a trauma for plants, more than a convenient alibi for eco-sabotage. Life's summer was the harbinger of the doom the Unity risked at each inward plunge of the orange sun. The geological record revealed several sudden and major shifts in Chel Kra's axial tilt; the fossil record showed massive die-offs on each such occasion.

Primary's miserly planetary system offered no good alternatives. Besides Chel Kra, there were but two very hot worlds within Chel Kra's orbit, and, outermost, a small gas world with a few rocky moons. Secondary had only three planets, and for a similar reason. Each sun on its looping orbit about the other had long ago ejected into the interstellar darkness any planets that had formed farther out. Primary's influence on the remaining planets of its smaller, dimmer companion made life on them even more precarious.

Would the Unity survive the massive death and destruction a major change in axial tilt would cause? Probably—but could the survivors continue to maintain a presence in space? A second axial shift before the Unity regained its strength and capabilities might be fatal.

The mission to the K'vithians had always been a means, not an end. It was to have been a larger-scale demonstration of feasibility than the jaunt to the Red Companion. K'choi Gwu ka had hoped it would lead to colonizing missions to stellar neighbors not much farther away. A colony at such a distance *must* be self-sufficient from the start—self-sustaining no matter what calamity might happen at home. Her species, for the first time in its history, would be safe. *That* had been her ultimate goal for this mission.

Instead, the mission's failure would sunder the delicate consensus that had sent *Harmony*, would tip the societal balance yet more towards conservatism and retrenchment. It would discredit interstellar travel for a very long time. For too long?

The Unity came first. She would protect it at *all* costs.

The work team waded through thick and fetid waste, the clotting filth rising over their second highest tentacle joints. Imagination recreated without difficulty the stench of the excrement and rotting leaves that lapped against sealed protective clothing. Strings of overhead lamps receded from the twisted and burst hatch of the reservoir, a coating of muck turning the bright yellow glow of the ceiling LEDs a dim green-brown.

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Gwu plodded into the gloom, one tentacle held high clutching a sonar scanner. She carefully examined her self-assigned segment of the recycling tank.

Soon enough, a shout came from across the tank. "Here is something," called T'Brk Cha. After two interstellar crossings, no one on board was young, but Cha was among the youngest. Moving slowly to avoid slipping, the other seven members of the work crew slogged through the viscous mess to Cha's side. "Look at this." He sounded as surprised as she had hoped.

The youngster had found a burst pump awash in the muck, as Gwu had known he would. Her latest memory-chip message to T'bck Ra had asked the AI to overload and overheat something in an effluent reservoir, something that would cause a methane explosion.

She was determined to have the benefit of the crew-kindred's wisdom. This small representative group was as close as she could get—but she had to speak with them privately.

There was no evidence of K'vithian bugs inside the tanks, in which all ship's waste was slowly and organically recycled into fertilizer for the farms. As Gwu had expected, the K'vithian guards had halted far from the rupture in the farm floor—a good ten tentacle lengths distant, where the spatters of waste matter remained sparse. The work team was alone and unsupervised but for their suit radios. Gwu gestured with a dripping tentacle: suit microphones off. Touch helmets.

"K'tel Da and T'Brk Cha," she whispered. "You are to repair the pump—slowly. On my signal, reactivate your microphones. Speak to each other for the benefit of the guards outside. Complain about connections stuck shut by this muck. Curse about dropping slippery parts into the slime, and groping to find them. Talk to the rest of us, calling us by name, when you can grunt in response. Grumble how difficult it is to read part numbers because everything is corroded. When the guards bring replacement parts—and someone will, to get briefly away from the stench—manage to drop them into the tank. That clumsiness will be believable, since your sleeves are coated with this slime.

"Stall to give the rest of us time to consult—and let me know *immediately* if the guards sound suspicious." She waved them away from the cluster. They began chattering in her earphones, the volume lowered but still on lest a guard call her.

She guessed they had a few minutes.

"My friends, we have a serious matter to consider. Your wisdom must represent the entire crew-kindred." And we must discuss this matter with uncharacteristic speed.

"What is the issue, ka?" K'tra Ko, a mid-level supply officer, spoke first. Others murmured in agreement.

For long years she had yearned for this moment. Now all her private thoughts and doubts, all her inferences and suspicions and fears vied for immediate release. *This is not about me, nor is there time to explain everything.* She must hope she had retained their confidence. "The Unity believes us lost, our mission a failure. The K'vithians have taken our interstellar-drive technology. With human help, they are about to master antimatter."

"What about . . . who . . . how . . . but would not. . . ." Except for human involvement, she had revealed nothing they might not have already surmised. Their sudden volubility came more from the opportunity to speak freely than from news. Only Swee did not speak, his silence an affirmation of support.

"Softly!" In a lower voice, she continued. "We dare not be overheard. There is more. Please allow me to finish."

That a lifeboat was gone from its bay had become common knowledge. That it had been tampered with to simulate erratic drive behavior was not.

A subtle exchange of glances established T'chk Dwu, a biosphere engineer,

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as the team's spokesperson. "How can you know these things, ka?"

There were nuances of doubt in the furtive looks and the whispered question. For much of the journey to Sol system Gwu would have welcomed release from her duties. From the failures of her leadership. That was then; she must not fail now to persuade. "The K'vithians do not know it, but T'bck Ra is reactivated." Another eruption of intense whispering took longer to suppress. How long before their guards became impatient? "I am sorry there is insufficient time to explain fully. We cannot expect soon to have another unmonitored gathering."

As succinctly as she could, Gwu made her case. Her fear that three apparent failures—the crew-kindred's retreat into suspended automation, the disappearance of the *Harmony*, and most recently the rigged lifeboat disaster—would cause the Unity to abandon interstellar travel. Her dread of the Unity remaining forever at risk of an axial flip, trapped by its misunderstanding of the disastrous mission. *How terse and emphatic—how much like the Foremost—I have become.*

Her turned-down earphones buzzed with the guards' growing impatience. T'Brk Cha improvised that the pump must have failed long before it overheated to spark the explosion. They still needed to clear long-clogged pipes. Gwu hoped the translator would not recognize the panic in the youngster's voice. "We must finish," she told the huddled team.

"Ka, what do you suggest?" T'chk Dwu asked. Anxiety had displaced the recent hint of skepticism in his voice.

"I believe the Unity must be informed the technology works. A crew-kindred *can* safely cross interstellar distances." Even though it had taken K'vithian hijackers to keep us awake as their technicians. She squeezed Swee's tentacle. "Whatever the consequences to us. What are your thoughts?"

The latest stunned silence gave way to new murmurs: of confusion, shock, even sympathy for her burdens. None questioned that the reawakened T'bck Ra would get only one chance to send their desperate message. None would risk that opportunity to communicate on contacting the humans, with whom their captors were evidently allied. None doubted the K'vithians would exact harsh retribution.

And none put personal wellbeing before the safety of the Unity. The whispered consultation converged quickly to agreement with her proposition. Never had she been more proud of the crew-kindred and of her kind.

But were they too late?

CHAPTER 23

The shift of the mission's next all-hands meeting to Valhalla City's poshest hotel was a giveaway: Something big was in the works. When Art and Eva arrived, they discovered the initial hour was a reception. No one in the milling crowd had any better idea than she what was being celebrated. Curiosity seemed only to whet the appetite for wine and hors d'oeuvres. Eva was content to nibble as others speculated.

Ambassador Chung, surrounded by aides, swept in near the end of the hour. He glad-handed his way through the ballroom to the dais, where he tapped on a microphone. "My colleagues"—brief toothy grin—"I hope everyone is in a party mood."

She could only shrug to Art's whispered, "What's he done now?"

"As has been covered at past meetings, the mission holds delegated authority from the UP to negotiate a mutually beneficial refueling agreement with our K'vithian visitors. I want you, my colleagues, to be the first to hear that those negotiations have finally borne fruit."

Back-to-back "my colleagues" from a very non-collegial guy. Whatever Chung planned to announce had been decided

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by a smaller group than the full team. Her guess was: by Chung alone.

"The Foremost and I held an unusually productive meeting just two days ago, at which he acknowledged the UP's significant investment in antimatter production. He did me the honor of a personal meeting in his cabin aboard *Victorious*.

" 'I cannot,' the Foremost said to me, 'repay financially. The need to acquire fuel for the return trip was never imagined, and so never planned for.' " Chung raised his hands to deflect an outburst of questions. "That is when he made an offer far more valuable than any amount of Intersols. Mashkith said, 'InterstellarNet began with simple barter, and I propose that we respect that precedent. What I offer in trade will make worthwhile the UP's antimatter capability . . . interstellar-drive capability.' "

There was a moment of silence, and then a torrent of cheers and applause. As the ovation finally subsided, Eva raised her hand. "Ambassador, what are the arrangements for instructing us in the new physical principles?"

Chung nodded his head thoughtfully. "An excellent point, Doctor. As it happens, the trade will work slightly differently."

What? "With all respect, sir, what does that mean?"

"The K'vithian mission parameters never anticipated refueling here, nor the accident-related need for major resupply. We've understood all along that meant they didn't bring mega-funds. But it *also* means they never envisioned transferring the interstellar-drive technology. Asking now for that authorization would entail a twelve year wait—with no guarantee of the outcome."

"But you just said. . . ." Eva stopped, too angry to speak.

"The Foremost found what he considers a solution to this dilemma—what you or I might reasonably consider a rationalization. A loophole. If you wish to think of it this way, he is ready to bend the rules rather than be stranded here. He was expressly ordered to keep secret the interstellar-drive theory, but nothing in his instructions says he can't swap his 'surplus equipment' for our 'surplus fuel.' The surplus equipment he offered us is a lifeboat equipped with interstellar drive."

"This is incomprehensible." (The netted version of Art's outburst said "insane." Her netted reply hedged agreement.) "To converge upon an antimatter-exchange method, we had to share a great deal of our research with the Snakes. The K'vithians. *Now* they say they won't trade on an equal basis?"

"The K'vithians already have antimatter technology," Chung said. "We have seen it demonstrated. They want *antimatter*, not theory, from us. They investigated BEC technology only to convince themselves they can take delivery of our fuel within an acceptable level of risk."

"Can we operate a spaceship whose drive we don't understand without putting *ourselves* at risk?" Art shot back.

Chung sniffed. "The Foremost assured me the drive mechanism is simple to replicate and operate. And, of course, lifeboat controls are designed to be meaningful to any crewman, not accessible only to specialists."

How many alternate drive mechanisms had been hypothesized over the years? How many theories, each with its associated experiments, had split the never adequate R&D budget? Possessing a drive that worked would let the UP direct its future efforts much more wisely. And surely she could infer much by careful observation and measurement of a working starship. The trade made a kind of sense—not just to Eva, but to the dozens contributing to the rising buzz in the ballroom.

"What do you think, Art?" she netted.

"Honestly? I don't know what to think. I only know it doesn't *feel* right."

A hundred moons, asteroids, and ships across the solar system emitted a

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carefully timed salvo. Part of the barrage took the form of collimated beams; the rest came in high-energy pulses. No warning—no signal of any kind—could outrace the speed-of-light onslaught to its target nearly a light-day distant. The converging energies fluctuated every few nanoseconds, randomly hopping frequencies and altering modulations.

Two days later, the echoes of those simultaneous radar and lidar probes had returned to their sources. Outgoing and returned wave data, position- and time-stamped with utmost precision, had been forwarded to *Actium* and run through a battery of precise correlations. Wall screens and holo tanks now presented the analyses from every possible perspective, and in dizzying detail, but Art found the bottom-line result unambiguous. The target in the outer fringes of the Kuiper Belt had traced precisely the elaborate trajectory the Snakes had predicted.

IR instruments, as forecast, had seen nothing—even when radar insisted the object had been decelerating while aimed directly at them. That eliminated fusion. Some had imagined an intense beam source hidden on a nearby proto-comet, but the object swooped and swerved far more adroitly than any sail-based propulsion could possibly accomplish.

Meanwhile, gravity-wave observatories were scrambling to interpret a flood of data. Eva was like a kid in a candy shop. Quantum gravity was her specialty and passion; her repeated best efforts had yet to get Art deeper than five minutes into a description of her research.

"Damn," he said. It was an expression of wonderment, not anger. "It's for real. I can't imagine how that many varied observations could be faked." The test had been designed in consultation with UP military and UPIA experts, whose most advanced experimental jammers and spoofers could not fool even a fraction of the electromagnetic probes just deployed. "There is a real object out there with a real interstellar-drive capability." Excited voices across the crowded bridge agreed.

Ambassador Chung managed to simultaneously beam and scowl. The scowl, Art assumed, was for his sole benefit. "The K'vithians told us they have anti-matter capability—and they proved it. They said they have a lifeboat equipped with a non-reaction, interstellar drive to offer us—and they proved that. Dr. Walsh, does your cynicism require any additional hugely expensive experiments insulting to our guests?"

Why wasn't he convinced even now? As though reading Art's mind—but more likely the doubts plainly written on his face—Keizo privately netted his mantra, "Aliens are alien." Meaning: It's unreasonable to expect always to understand the Snakes, or their approach to problems, or what data about themselves and their most prized technology they volunteer. Meaning: Eva's frustration that questions about the interstellar drive were invariably deflected proved nothing.

All eyes were on Art, awaiting his response.

Objectively, how could the answer be in question? The drive was said to be unsafe to operate deep within gravity wells. He could hardly expect the Foremost to sacrifice a vehicle to prove that. He faced Chung squarely. "No, sir."

But in Art's heart there followed a caveat: none at this time.

"Knight capture by pawn." Mashkith slapped the chess clock.

"Bishop capture by bishop," replied Lothwer, hitting his side of the clock. "Check."

"Bishop capture by queen." Tap. Mashkith's mind was not on the game, but it seemed an appropriate way to await final word from the humans. If he could have spared his full attention, they would have been playing b'tok.

The familiar panoramic holo of Jupiter and Callisto dominated his cabin, but

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Mashkith was cognizant of a major change. The swarm of freighters had thinned to a few. Resupply was largely complete. "Environmental system status?"

"Near nominal again." Lothwer advanced a pawn and tapped the clock again. "Sulfur dioxide levels in the farm . . ."

"Incoming announcement from Earth, Foremost. On all major news sources. On time delay."

"Acknowledgement." His answer, like the watch officer's alert, was netted. Another subvocalization opened an inset box in the holo. "From the start."

Into the inset popped a cloth-covered lectern bearing the great seal of the United Planets. Ambassador Chung emerged from a backdrop of heavy curtains, clutching a sheaf of notes. Stepping up to the podium, he cleared his throat. "My fellow citizens, I am here to make a statement.

"As you know, I lead the contact team which works closely with our interstellar guests. It has been my privilege to report regularly on our progress, just as I am certain the Foremost, leader of the K'vithian visitors, has enjoyed. . . ."

"Knight to queen six." Tap.

Mashkith wavered between approval and irritation with Lothwer's casual bravado. True, an announcement was expected. Its content had been negotiated in detail with Ambassador Chung before his final trip to consult with the UP secretary-general. But the broadcast represented the culmination of a plan so *long* in execution.

". . . And so I am pleased to report the successful conclusion of an extraordinarily important dialogue, as a result of which United Planets researchers will receive a working copy of the K'vithian interstellar drive. In exchange, we will begin immediately the complete refueling of *Victorious* from UP stocks of antimatter."

And thus, after so *long* a time, everything had come together. Mashkith found his ears were wriggling. Lothwer's were too.

It was hard *not* to gloat when the humans were always so cooperatively several moves behind. ■

To be continued.

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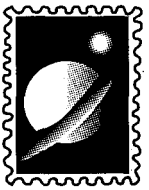

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The Armies of Memory, John Barnes, Tor, $25.95, 429 pp. (ISBN: 0-765-30330-2).

The Cunning Blood, Jeff Duntemann, ISFiC Press (www.isficpress.com), $28, 360 pp. (ISBN: 0-9759156-2-3).

Starship: Mutiny, Mike Resnick, Pyr, $25, 286 pp. (ISBN: 1-59102-337-8).

Pretender, C. J. Cherryh, DAW, $25.95, 327 pp. (ISBN: 0-7564-0374-X).

The Coming of Conan the Cimmerian, Robert E. Howard, Ballantine/Del Rey, $29.95, 468 + xxvi pp. (ISBN: 0-345-48385-5).

The Alchemy of Stars: Rhysling Award Winners Showcase, Roger Dutcher and Mike Allen, eds., Science Fiction Poetry Association, $15, 170 pp. (ISBN: 0-8095-1162-2).

The James Tiptree Award Anthology 2, Karen Joy Fowler, Pat Murphy, Debbie Notkin, and Jeffrey D. Smith, eds., Tachyon Publications, $14.95, 250 pp. (ISBN: 1-892391-31-7).

Civilized Life in the Universe, George Basalla, Oxford University Press, $29.95, 227 + xiv pp. (ISBN: 0-19-517181-0).

Over a decade ago, John Barnes posited that the human species will proliferate in the galaxy and settle a hundred worlds (or so) with splinter cultures derived from ethnicity, history, religion, and myth. When instant travel via matter transmission or "springer" is invented, all these cultures will be put in touch with each other, and the Office of Special Projects will take on the goal of keeping the species unified against the day when the aliens—whose wrecks and ruins have been found—finally appear.

A Million Open Doors (reviewed here in February 1993) introduced Giraut Leones, a rowdy troubador in a culture dedicated to Romance. By *Earth Made of Glass* (reviewed September 1998), Giraut was a special agent of the OSP; his mission, to save two cultures from self-destruction, failed with the loss of a world and Giraut's own marriage. In *The Merchants of Souls* (reviewed June 2002), Barnes introduced the psypyx, a recording of the mind. It is the practice to have such recordings made periodically. If the body dies, the psypyx can be attached to a volunteer friend and nurtured (time-sharing the friend's brain, with conversations between the two occupants of one skull quite possible) while a new body is cloned. A psypyx is thus a backup self, a soul if you will, and now, in **The Armies of Memory**, he makes full use of the gimmick.

Someone is trying to assassinate Giraut, rather clumsily, and soon it is learned that the assassins are chimeras, bodies that look human but whose minds are formed by the merging of multiple psypyxes. There are hints that an unauthorized colony beyond the edge of human space, Noucatharia, is involved. And when his girlfriend dies, she turns out to be a chimera too—but the added mind is not from a psypyx. It's from an aintellect or artificial intelligence, and humans have a horror of aintellects ever since they were caught trying to take over. There is a fear that they will try to push everyone into the VR box, as so many back on Earth have indeed chosen.

If all this sounds familiar, three excerpts from the novel have appeared here, the last being "The Little White Nerves Went Last" (March 2006). Giraut is kidnapped to Noucatharia, one of the many worlds of Union, where he is im-

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planted with the psypyx of his old boss Shan, who finally reveals where the springer really came from and the threat of the Brain-Eating Aliens from Beyond, which the Noucatharians have already encountered. It looks like humanity will need all its forces, including the sheer numbers and novel tech of the Union worlds, represented for the moment by Noucatharia, to survive the threat.

Giraut also learns that when an aintellect is implanted in the brain of a human cloned body (no human mind present), it quite likes the experience and comes across as quite a pleasant, interesting person. Or persons, since there is no rational limit on the number of an aintellect's instantiations. The VR box is no real threat, but a robot in a human body (or bodies!) still gives many folks the horrors.

Should it? What is a mind, really, and is any particular type of mind sacred? The OSP's mission is supposed to mean fostering diversity, as a means to being prepared for the alien threat. Are there limits to diversity? If you make love to a robot in a human body, are you a disgusting pervert? And what do you do to a human hero—Giraut, of course—who aids and abets the enemy, meaning the disgusting, treacherous aintellects in human disguise?

"The Little White Nerves" did not take things quite that far. I will not say much beyond this: human sacrifice, especially self-sacrifice, is a classic step toward changing paradigms and accomplishing great things. But when the last page is turned, the great things remain in the wings.

Even though the cover blurb calls this the final novel in the series, it does not feel very final, and I have been enjoying this series far too much to let go of my hope for one more volume. When I asked, Barnes assured me that the sequel, *A Far Cry*, remains on his agenda and may even wind up short enough to be an *Analog* serial.

* * *

ISFiC Press scored a coup when it got its hands on Jeff Duntemann's **The Cunning Blood**, which I would not have been surprised to see appear from a major publisher such as Tor. Duntemann made a good impression on readers back in the 70s, before shifting his writing to the tech side (including ten books on computing). He returns with an ambitious, polished tale of intrigue, nanotechnology, and something that sounds a lot like mysticism.

Blood's backdrop is a universe where every Sunlike star has an Earthlike planet with *very* Earthlike life. Why? People speculate about ancient astronauts known as Gaians, and when ships such as the *Yellowknife* disappear, guess who gets blamed. Earth itself is ruled by Canada. Perhaps because Canada is a fairly polite place today, the new regime has zero tolerance for violent behavior and ships offenders to a world called Hell, where nanotechnological gizmos floating in the air destroy anything that uses electricity (they attack conductors carrying current). The intent is that Hell's denizens will never be able to develop modern tech and escape.

But . . . Duntemann opens with the descent of an emissary from space, bearing high-tech gifts—fluorine-based chemical lasers—for the local tech-deprived yokels. Much to his surprise, he lands in the middle of a battle involving robotic dinosaurs and missiles and soon discovers that electronics have been replaced with fluidics. The yokels aren't so tech-deprived after all, though the new laser toys are still welcome.

Meanwhile, back on Earth, the Sangruse Society—people who bear copies of the nanotechnological consciousness called Sangruse—are plotting to help the Governor General of America put a member on Hell and even bring him back. That member is Peter Novilio—cocky, impetuous, risk loving—and as soon as he has committed a suitable offense, he is off as the ostensible bodyguard for secret agent Geyl Shreve.

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When they arrive Peter is promptly recruited as an engineer for Rho Alpha Delta (the Ralpha Dogs—surely an homage to Ralph von Wau Wau), who turn out to have not only alternatives to electricity but also ways to make electricity work. Everything seems quite plausible enough to delight *Analog* readers; Duntemann is clever, even before he gets into the tricks his nanotech can pull. And when he goes there, well, Sangruse would be a miraculous thing to have inside you, if only it did not have its own agenda.

Fortunately . . . Remember that emissary? He came from the Interstellar American Republic, which is plotting an attack on Canadian rule. We see it through the eyes of Jamie Eigen, also a Sangruse carrier (thanks to Peter), and very soon we meet Magic Mikey, a young savant who has found a way to image the very substratum of spacetime, where something strange is going on. Since the IAR has the *Yellowknife* (and other missing ships), the putative Gaians aren't working on the macro level. Are they here instead? Or is it the souls of the dead? Jamie uses that notion to scare the agenda right out of his copy of Sangruse, and now the stage is set for a final confrontation of all the various forces Duntemann has set in play, all to marvelous gosh-wow-gee-whiz effect. There is even a hook on which to hang a sequel.

This one has a decent chance of showing up on award ballots.

Mike Resnick begins a five-volume series with **Starship: Mutiny**. Space opera in the classic vein, *Mutiny* begins as Wilson Cole reports as first officer aboard the *Theodore Roosevelt*, a superannuated warship staffed by misfits and screwups. Cole's error is that he has embarrassed the brass by being right too many times, and he isn't about to quit. He's barely begun his duties when he spots an enemy ship on a Republic world, and pulls the *TR* away from its beat to check things out. Being the officer on deck, he neglects to wake the captain, who would surely tell him to stay on patrol and just call in the alarm.

But Cole knows the Republic's forces are so overextended that this enemy will not be interrupted in its nefarious mission. Even though the *TR* is hardly up to a battle, he decides to give it a go. In the end, he manages to make enough fuss, without firing a shot, to draw the troops in. He gets another medal, so does the captain, and he's once more in the deep doo-doo.

Does he have enough sense to quit while he's ahead? Of course not. He's a hero to the public and his crew. So when the *TR* is given another assignment and the captain is replaced by an even more rigid martinet, he wastes no time in exceeding his orders once more—again to excellent if brass-embarrassing effect. Unfortunately, this time he has to seize command from his captain. He's guilty of mutiny, and the court-martial awaits, complete with death sentence.

Four volumes to go? *Pirate, Mercenary, Rebel,* and *Flagship*. The story arc is clear: jailbreak, acclamation by the crew, declaration of independence, and hi-ho for the Inner Frontier and the life of a pirate, at least to start.

Resnick's Birthright Universe has been a fruitful playground for many years. It has given rise to some pretty meaty works, and to a number of lighter ones. This is in the latter category, for the basic story has been told and retold by many writers. However, few writers have Resnick's gift for pace and momentum, nor his talent for producing a fast, smooth, utterly effortless read. Buy this one to read while traveling; it's just about the right length for a plane ride from New York to Chicago.

Once upon a time, in a galaxy far, far away, the starship *Phoenix*, laden with the builders and residents of a planned station, got lost in space, and built a sta-

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tion, Alpha, in orbit above a world whose humanoid natives, the atevi, had a technology roughly equivalent to nineteenth-century Europe or America. The Stationers soon rebelled against their leaders and landed. The ship and its crew departed.

It took two centuries for the humans to learn to get along with the atevi, for their hard-wired responses to each other and their world were very different. By the time C. J. Cherryh discovered them, Bren Cameron was the "paidhi" whose job was to interpret humans to atevi and atevi to humans. It was a high-stress job, complicated by differences in both psychology and politics.

Meanwhile, the ship built another station, Reunion, and ticked off another alien species. When the *Phoenix* returned from a journey and discovered a blasted station, it hightailed it back to Alpha to demand assistance. Since neither the human colonists nor the atevi had space travel yet, there was a bit of work to do, but it didn't take long to build the necessary infrastructure and start repairing Alpha. When the *Phoenix* finally left, it carried Bren as the atevi "Lord of the Heavens" along with the atevi overlord's young heir Cajeiri and grandmother Ilisidi, plus of course their personal staffs and security troops. By the time the mission was over, the Reunioners were rescued and Bren had figured out how to talk to the new aliens. He had also learned of still more aliens who just might pose a serious danger to both humans and atevi, and when he got home, he was hot to pass the word. Unfortunately, the atevi uberchief, Tabini, had been deposed and the shuttles were no longer flying. Bren, Ilisidi, Cajeiri, and their people wasted no time in boarding the one available shuttle and heading down, winding up at the country manor of the irascible Tatiseigi and under attack by the usurper's forces.

That much took seven volumes—*Foreigner, Invader, Inheritor, Precursor, Defender, Explorer*, and *Destroyer*. Now we have **Pretender**, in which the people rally to the cause and march on the capitol, the usurper is overthrown, and Bren finally gets to give his report. As usual, Bren does a lot of internal agonizing over how badly he has screwed up and how little he really understands the atevi, but Cherryh makes it abundantly clear that a great many atevi think very highly of him and blame him much less than he does himself. Cajeiri grows up a bit more and bids fair to be a worthy successor to his father when the time comes. And all the other aliens remain offstage for the nonce.

Some readers may have difficulty with Bren's internal obsessiveness, but Cherryh has the gift of making even that move smoothly and quickly. My own biggest problem is that I wish Cherryh would move the story further in each volume. At the rate she's going I may not live long enough to read the end of the story!

Conan is back!

Not that he has ever spent much time away in the three quarters of a century since Robert E. Howard devised the archetype of the mighty-thewed barbarian swordsman, slayer of monsters, and rescuer of damsels for the pages of *Weird Tales*. Others have taken up the pen Howard set down at his suicide in 1936, and both movies and imitators have glorified the trope. **The Coming of Conan the Cimmerian**, illustrated nicely by Mark Schultz (he write the *Prince Valiant* comic strip) and introduced by Patrice Louinet (French editor, teacher, and Howard scholar), gathers together thirteen Cimmerian tales, beginning with the first, "The Phoenix on the Sword," along with an assortment of drafts, notes, synopses, maps, and appendices (by Louinet) on where it all came from. Read them, and understand the roots of much modern fantasy, even unto the modern video game.

This book was first published in 2002. This is the first US trade hardbound.

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* * *

The Science Fiction Poetry Association (http://www.sfpoetry.com) has been giving the Rhysling Awards for the best SF-related poetry of the year since 1978, when Suzette Haden Elgin founded the SFPA. **The Alchemy of Stars** displays the results to date, many of which remain as impressive as they were when they won. Rhysling winners include familiar names such as Elgin herself, Joe Haldeman, Gene Wolfe, Michael Bishop, Ursula K. Le Guin, John Ford, Jane Yolen, and William John Watkins, as well as many known only for poetry, such as Robert Frazier and Bruce Boston.

An essential purchase for anyone's library of SF, and the perfect gift for a school or community library.

One of the great stories of science fiction is that of James Tiptree, Jr., who quickly earned a grand reputation for understanding women and—much to everyone's surprise (did they really think only men could write great SF?)—turned out to be Alice Sheldon. Her gift was great perception targeted at human folly, as in her most famous short story, "The Women Men Don't See." A few years after she committed suicide in 1987, age 72, Karen Joy Fowler and Pat Murphy founded the James Tiptree, Jr., Literary Award (funded in part by bake sales at cons) for SFF works that "explore and expand gender." Winners of the award vary tremendously, with some (such as Raphael Carter's "Congenital Agenesis of Gender Ideation" fitting the prescription so well that they might have been written in an effort to cop the prize. Others, such as Joe Haldeman's *Camouflage* (serialized here, remember?), make sense only on second or third reflection.

Both of these stories, along with nine more, an essay, and one of Tiptree/Sheldon's letters that reveals much about her mind, are to be found in **The James Tiptree Award Anthology 2**. Call it essential to any moderately ambitious SF collection, and buy yourself a treat.

Just in case you've ever wondered why people believe in flying saucers, space aliens, or SETI, George Basalla points out that human beings have long believed in superior heavenly beings. Sure, once that meant angels, demons, and assorted gods, but it really didn't take long at all to move beyond that. Even some ancient Greeks suggested the existence of an infinite number of universes, each with "its own sun, planets, stars, and life forms." (p. 4)

In **Civilized Life in the Universe**, Basalla takes the tale from that point onward and makes the connections to religion obvious. Some modern SETI researchers even seem to have their motivations rooted in fundamentalist Christian backgrounds! Yet religion is hardly the whole story. As he notes, "Two powerful strands run through the scientific search for extraterrestrial intelligence. The first strand is religion. There is religious sanction for populating the heavens with superior beings. The second strand is anthropomorphism. This is the tendency to describe the intellectual and social lives of those beings in human terms." (p. 197)

His explication of these strands makes for a fascinating angle on the history of SETI. However, Basalla is a historian, not a scientist. He therefore leans a bit too much toward the fallacy of saying that science is a social construction and that therefore the science of an alien species may not be comprehensible to humans. Yes, any intelligent being is going to focus its attention on matters of concern to it. But the universe is what it is, and the definition of science is the search for understanding of that universe. Since the laws of physics and chemistry are the same everywhere, intelligent species must share their understanding of those laws. Are there similar laws of biology? Of course, though we must try to avoid the parochialism of familiar

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chemistries and forms. Natural selection (what works, lasts) must apply everywhere, as must the need for energy and raw materials and reproduction.

Must intelligent species build radio telescopes or be interested in communicating with us? Basalla errs when he suggests that the assumption that they must is mere anthropomorphism, for the assumption is not that all aliens must do so, but that only those we can have any hope of contacting must. Granted, people like Carl Sagan did not always make that caveat explicit, but in my reading of the field, few ever seemed to make the broader assumption.

That said, go ahead and buy the book. Read it with interest, and perhaps wonder why Basalla did not go so far as to call SETI an attempt to eavesdrop on the angels. His argument would permit that extension, and even—if he were an evangelist instead of an academic—charging SETI workers with the sin of hubris.

Hmm . . . There's probably a story there . . . ■

IN TIMES TO COME

Our July/August double issue features a dramatic cover by Bob Eggleton for Alexis Glynn Latner's novelette "Witherspin." Humans have long tended to reshape both themselves and their surroundings, and that tendency can only be expected to increase. Put a highly modified fugitive into a world designed to be exotic and challenging, and you get quite a tangled web of a story, and quite a picture!

C. Sanford Lowe and G. David Nordley present "Kremer's Limit," a self-contained novella that is also the beginning of something much bigger. Scientific research in the past has tended to require ever more and bigger investments of time, money, and equipment, but how far can that process go? Suppose, realistically, that you want to learn to make black holes for fun and profit. Even a prototype requires close coordination of massive construction projects done over decades on worlds of widely separated stars. The technical problems are bad enough, but when you throw in such inevitable problems as human attention spans, rivalries, and chicanery, it becomes an *enormous* challenge in every sense of the word—too big and far-flung to be contained in one story. "Kremer's Limit" gets the attempt underway, but the ultimate outcome is far from certain . . .

Richard A. Lovett's fact article is a fascinating look at what mantle plumes can tell us about what's going deep in the core of our native planet. We'll also have Part III of Edward M. Lerner's four-part novel *A New Order of Things*, and a wide variety of stories by such writers as Joe Schembrie, Ian Stewart, Shane Tourtellotte, Maya Kaathryn Bohnhoff, Carl Frederick, and Brian Plante.

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BRASS TACKS

Dear *Analog*,

I just finished reading "Dinosaur Blood" [January/February 2006] by Richard A. Lovett and enjoyed it thoroughly. It was whimsical and serious at the same time, especially the excellent opening paragraphs. The whole issue was very good, but "Dinosaur Blood" was my favorite part. If you cannot print this letter, please pass it on to Mr. Lovett. Thanks!,

Amber E. Scott

Dear Dr. Schmidt,

I picked up on a brief reference in Richard Lovett's interesting and thought provoking story, "Dinosaur Blood" in the January/February 2006 issue.

Rhona reports from her online search that she found a reference to a huge solar panel installation in New Mexico. What's interesting about the citation is that Rhona reports that the installation caused sufficient local climate change to cause severe thunderstorms and tornadoes that killed 1,500 people.

I am quite interested in seeing major solar panel installations in this country, out on the Gulf of Mexico, as well as elsewhere in the world, and wonder if Mr. Lovett knows of any climate studies that predict a negative effect of large solar panel installations.

I would have expected temperatures to drop if solar panels absorb energy from the solar flux.

I would have expected that heating of the existing desert terrain would result in heating of the air at least as great as would occur from a large array of solar panels, so that if the terrain were shaded, then air heating would actually drop.

Tom Hanson
Columbus, OH

The author replies . . .

Thanks Amber; "Dinosaur Blood" was one of the most fun-to-write stories I've ever done.

Tom, I'm thrilled that you picked up the reference to solar power and thunderstorms. It's in the story largely because I didn't want "Dinosaur Blood" society to be using such facilities, and was looking for a feasible way to foreclose the option. As far as I know, nobody's done any research on this. But it makes sense and I think somebody *should* look at it.

You asked about heating vs. cooling. Rhona actually had the same uncertainty. Her full statement was:

"They tried it back in the twenty-first century, but it didn't work. Something called the 'heat island' effect. Or maybe a 'cold island.' The literature is a bit inconsistent and they *were* sucking a lot of power out, so it might have been energy drain, not waste heat that created the imbalance—"

You can get a "heat island" effect even if the ground is shaded, because the solar panels might be darker-colored than the ground was. Then they could simultaneously produce electricity and heat up. On an energy-balance basis, the way this works is that light that would normally be reflected into space goes partially to producing electricity and partially to heating up the array.

With a big array, it wouldn't take a huge temperature change to produce thunderstorms. There *is* research on the urban heat island around cities like

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Houston and Atlanta. The studies, reported at the fall meeting of the American Geophysical Union a couple of years ago, found more (and bigger) thunderstorms downwind of big cities than upwind of them.

Alternatively, the solar cells could be lighter-colored than the land they replace. Then you'd get Rhona's "cold island." That's a lot more speculative, but it seems likely that you'd get an impact on diurnal airflow, with down-flow in the center and rising thermals at the sides. At a minimum, you might get some exotic edge effects at the sides of the array. Instead of creating a big thunderstorm cell in the interior, you might get a ring of them around the outside.

The operative word here, of course, is "might." I'd love to see a climate modeler take a crack at this. From the point of view of the story, of course, all that matters is that Rhona's civilization tried, botched it, and gave up. I can think of some possible fixes, but that might be another story, and her civilization wouldn't have tried them.

Dear Dr. Schmidt,

I enjoyed the short story "Report on Ranzipal's Plus-Dimension Carry-All" in the January/February 2006 issue. Unfortunately, it spoiled the rest of the issue for me. I just couldn't get the technology off my mind. The idea of "pocket universes" (PUs) intrigued me greatly. I don't know if the author, Mr. Tiedemann, has written more stories using this concept. If so, I would truly like to read them. It just seems like there are so many possibilities for future stories.

If a fanny pack size carry-all can contain a baby grand piano and more it must be capable of great expansion. If this pack is easily portable, its power requirements must be very low. If it can absorb 150 kilograms (for at least short periods of time, on "overload") then there are a lot of options. Some questions/ideas that occurred to me are (in no particular order):

This seems like a perfect soldier's pack. This would certainly lighten the load soldiers today are expected to hump. Also, it would seem that this could be an instant foxhole or bunker. The only exposure that a soldier would have is through the mouth of the bag. If the fanny pack unit is hardened sufficiently, it could withstand even a nuclear explosion. There would have to have provision for air supply for extended stay. I suppose that there would have to be a way to vent heat generated inside the bag too. Without that, someone could cook from his or her own body heat.

Camping could be affected. Right now, there is a minimalist philosophy in camping based on what you can carry on your back. That may be appropriate. If the PU technology is embraced, every man could be his own "Winnebago". Energy usage would be critical. Even climbing Everest would be within the range of the middle-class. No base camping would be necessary. If supplementary oxygen were allowed, a strong mountaineering type would have no problem.

If a person can climb inside and stay for an extended period of time, this could affect transportation greatly. If all a transport company needs to transport is something the size and weight of a fanny pack, they could either increase the number of passengers, or reduce the size of the transport vehicles. Either would increase profits. Safety would be increased. If a transport went down, passengers might not even be aware of it until they emerged at the end of the trip time. That might be awkward, but I'm sure that there would be communication between the real world and the pocket universe.

If you wanted to go on a vacation cruise, you could take your entire home with you. No strange sheets, mattress or cutlery to worry with. It's already yours. No strange room layouts, it's "Home" after all.

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If a person didn't want to deal with "normal" transit between home and work, there could be many alternatives. Strapping your unit into a powered skateboard, model aircraft, human-sized telerobot, etc. shouldn't be a problem. That should expand the current transit experience from what is currently experienced. Telecommuting is an option currently, but actually making the relocation without the necessity of encountering "difficult" people could be appealing. No smells, little risk to personal security, personal comfort by not having to leave our own personal space until the ultimate point of contact at the job would be very attractive.

I'm guessing that the only limitation as to what size of PU, and the amount of mass it could handle would be the power requirements. With increased power, a person could have their home in one easily-transportable package. With a larger power pack, it might not be fanny pack size. It might be backpack size. For people that are highly mobile, this could be very convenient. Some people might never have to really leave the office, but still go home. Just plug in the backpack to a convenient wall plug, stash the backpack at your desk, and 'Shazam' your ready to go. Management might frown on this. Or maybe not, they'd always have their workers "on-call" if necessary. This would give new meaning to the term "prairie dogging". Everyone truly would have his or her own hole. Waste disposal and water supplies in the holes could be a problem, but if water and waste storage each had their own fanny pack size PU, you could go for a long time on your own. Periodically these would have to be filled or emptied appropriately, but this could be done on an exchange basis, similarly to the way we do propane tanks now.

What if you lived in one of these units, and someone stole it while you were out? Worse, what if someone did it while you *weren't*? I'm guessing that each unit would have wireless communication so if you were snatched, you could scream for help electronically. I assume each unit would have a unique, traceable serial number, GPS signature, etc.

If units like this were to become mainstream, rather than having roaming "Winnebago" type existence, they could be tied to a kiosk type link. This would be opposed to traditional housing. The only link would be a "permanent" address and connection to site utilities. There would be different "classes" of kiosk depending on the level of utilities required. If a person wanted to appear as a high-roller, but only have a minimum investment, they could use even a back pack PU. I doubt that the hookup connections would be directly compatible, but adapters could easily be available.

I assume that if people can live in these units, that locks can be installed from the inside to prevent unauthorized entry. If the mouth of these units can be locked from the outside, kidnapping can be greatly facilitated. Smaller units could be fired at individuals, sort of a high-tech version of the netting that Arnold underwent in "Running Man". Depending on the size of the unit, an entire crowd could be snatched. Police could use this for crowd control.

Putting locks on the outside of the units opens up changes to the penal system. You could have as large a cell and as many amenities as you can afford, without affecting security much. Utility costs (power, water usage, etc.) would be paid for by the inmate, above a basic minimum.

Apartment buildings and prisons might greatly resemble one another. I envision these as being much more related to automated, computer-operated warehouses than traditional buildings today. If an occupant wants entry into or out of their unit, they signal the control unit, which selects the appropriate unit and transports it to a vestibule area for entry or exit. If a friend drops by for a

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visit, they either contact the control unit to request communication with the occupant, or contact them directly. If you want to interact face-to-face, you respond. If not, the visitor gets an answering machine type response.

An extremely large apartment block might require a series of vestibules and be organized similarly to airplane gates. If security issues are involved, a series of private booths might be utilized.

The possibility of having your own PU could broaden personal freedoms. If "the freedom to swing my arms ends at the tip of your nose", but there is no possibility of my actions affecting you, then my freedom should not be infringed. This could result in mini Las Vegas experiences ("What happens in Vegas, stays in Vegas"). This might require people to prove that what they do behind closed doors does not affect the larger world in any significant way. If these pocket universes are ruled to be outside the normal universe and applicable law, then anything is possible between consenting (or possibly non-consenting) individuals, animals, etc. This can yield interesting, if not down right scary, possibilities. Almost anything can be transported between PUs without any knowledge of outside authorities. If I want to order up a prostitute, she can be delivered to my door by courier, possibly within minutes (hot and ready to go, sorta like Domino's).

If these back pack units aren't too expensive they could be a great way to dispose of a body (bodies?). Just do the dirty deed, walk out, close it up, pick it up and walk away and throw the unit in the river or any convenient trash receptacle. I assume that once the power pack runs out, that the contents of the bag return to the normal universe. By that time, it might be in some location that would be difficult to track back to the perpetrator.

The original story details that an override mechanism releases the contents item by item, but I assume that a total failure or shutdown of the system returns all the contents into the real-world universe instantly. Depending on the size of the PU this might or might not cause a problem. A large enough PU collapsing into the real-world could cause what would amount to an explosion. A large zero-gee PU grid entering a real-world environment and collapsing could cause a real mess by itself. If there were environmental problems (chemical, biological, etc.) the problems would be exacerbated. Terrorism raises its ugly head again.

The possibility of larger PUs opens more variations on the basic soldier's pack. You could put the bulk of tanks, battleships, etc. into a larger bag and only expose gun ports, vision ports, tracks, screws, etc. exposed. This would minimize the need for armor, except on the exposed parts. You might even be able to "turtle up" and pull everything back inside for brief periods. Elimination of the weight restrictions on vehicles puts no limitation on engine or crew size. With inertia virtually eliminated, maneuverability is maximized. What conventional vehicle could compete?

If you just want to use a conventional vehicle, the use of PUs could be the perfect armor. If you open the mouth of a PU to every side of vulnerable vehicle, nothing can get through. Even a nuclear weapon would just go down the rabbit hole, and never affect the target, even if the enemy could detect it through the shield of the PU. The use of PUs as armor could be limited by visibility "back to front" through the mouth of the mouth of the PU. As the PUs aren't really part of our universe, I'm guessing that that they'd be transparent, or virtually so. This isn't addressed in the original story.

Space vehicles would be particularly affected by the use of PUs. Everything but exhaust, sensors, telemetry etc. outside the PU would be massless. Tank size, engine size, crew compartment volume, etc. would be irrelevant to

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flight performance. Speeds would be increased and transit times would be greatly reduced dramatically. Generation ships might not be required to begin colonization of other planets.

If gravity were eliminated inside the units, what would the space inside be like? I am assuming that the volume inside is only defined by the object or objects inside. Even a light-weight structure could define a large volume. I don't think people would be comfortable in a large-volume space that they could be trapped in due to zero-gravity. I'm guessing something like a giant "monkey bars" arrangement would be better. This would provide a framework to fasten appliances, equipment, etc. to. What comes to mind is the traditional Japanese partitioning of space using even something as insubstantial as rice paper.

Zero-gravity inside the units could cause interesting aspects to a story. Life-extension is one aspect. Loss of bone mass, similar to that experienced by astronauts, could cause people to be confined to a zero-gee experience. I thought that this would imprison people in the homes, but then it occurred to me that pocket universes wouldn't be confined to residential use. Commercial use would probably be more significant than just the residential. If you can have an entire factory or warehouse in one of these units, with little, or no real estate requirements, that could be a real advantage over a traditional arrangement.

Again, if the PCs are judged to be outside the normal universe/rules/laws, then the tax position is affected.

Does gravity *have* to be eliminated? If a PU had a large opening/volume ratio and was oriented horizontally, the PU is more a dome than a pocket. I think that this would give gravity in the PU. Of course, it's less of a true pocket universe than others.

If a person lives in a zero-gee PU and wants to visit another PU all they have to do is contact a transport company to do the transfer. If the "real world" unit is small enough, this could even be a bicycle courier. Depending on security levels, weight of the unit, etc. this could be left up to an armored car company or even more. Once the PC is transported into the new PC, the occupant exits from one zero-gee environment into another.

This could cause a two-tier situation. Conflicts between a rich, old, zero-gee, PU population and a young, poor, normal universe population would be almost inevitable.

Pardon the constant military applications, but a single soldier could have all the power of a current nuclear submarine. Stealth/terrorist applications are rampant. Heat-sinking would be critical.

Please pardon me if this isn't he most elegant, ore even organized email you've received. I dashed it off within 12 hours of reading the story.

Michael Click ■

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UPCOMING EVENTS Anthony Lewis

26–29 May 2006
BALTICON 40 (Baltimore area SF conference) at Marriott's Hunt Valley Inn, Baltimore, MD. Guest of Honor: Neil Gaiman. Artist Guest of Honor: Lisa Snellings-Clark. Musical Guest of Honor: Lorraine a' Malena. Special Guest of Honor: Gene Wolfe. 2005 Compton Crook Award Winner: Tamara Siler Jones. Registration: $43 until 28 February 2006; later to be announced. Info: www.balticon.org; balticoninfo@balticon.org; (410) 563-2737 (voice); (410) 879-3602 (fax); Balticon 40, Box 686, Baltimore, MD 21203-0686.

26–29 May 2006
MISCON 20 (Montana SF conference) at Ruby's Inn & Convention Center, Missoula, MT. Guest of Honor: Jerry Oltion. Artist Guest of Honor: Frank Wu. Special Media Guest: Dragon Dronet. Registration: $25 until 31 April 2006; then $30. Info: www.miscon.org; chair@miscon.org; (406) 544-7083; Miscon, Box 7721, Missoula MT 59807.

2–4 June 2006
CONCAROLINAS 2006 (Carolina area SF conference) at Marriott Executive Park, Charlotte, NC. Guests of Honor: Jeanne and Spider Robinson. Media Guest of Honor: Tony Amendola (Master Bra'Ta'). Registration: $35. Info: www.concarolinas.org, concarolinas@concarolinas.org, Concarolinas, PO Box 9100, Charlotte, NC 28299-9100.

23–25 June 2006
HYPERCON 2 (Nashville area SF conference) at Days Inn Stadium, Nashville, TN. Literary Guest of Honor: Tim Powers. Special Guests: Sherrilyn Kenyon, Brion Keene, Glen Cook. Registration: $35. Info: www.hypericon.info, hypericon@gmail.com, Hypericon, 6001 Old Hickory Blvd 411, Hermitage, TN 37076.

1–4 July 2006
WESTERCON 59 a.k.a. CONZILLA (Western North America SF convention) at San Diego Marriott Mission Valley, San Diego, CA. Guest of Honor: Walter Jon Williams. Artist Guest of Honor: Bob Eggleton. Fan Guest of Honor: Bobbi Armbruster. TM. Kevin J. Anderson. Registration: $60. Info: www.conzilla.info, info@conzilla.info, Conzilla, PO Box 845, Ramona, CA 92065-0845.

2–5 November 2006
WORLD FANTASY CONVENTION at Renaissance Hotel, Arboretum, Austin, TX. Guests of Honor: Glen Cook and Dave Duncan. TM: Bradley Denton. Editor Guest of Honor: Glenn Lord. Artist Guest of Honor: John Jude Palencar. Robert E. Howard Artist Guest: Gary Gianni. Registration: $125 until 31 July 2006; supporting $35. Info: http://www.fact.org/wfc2006/wfcinfo@fact.org; FACT, Inc., Box 27277, Austin TX 78755. ■

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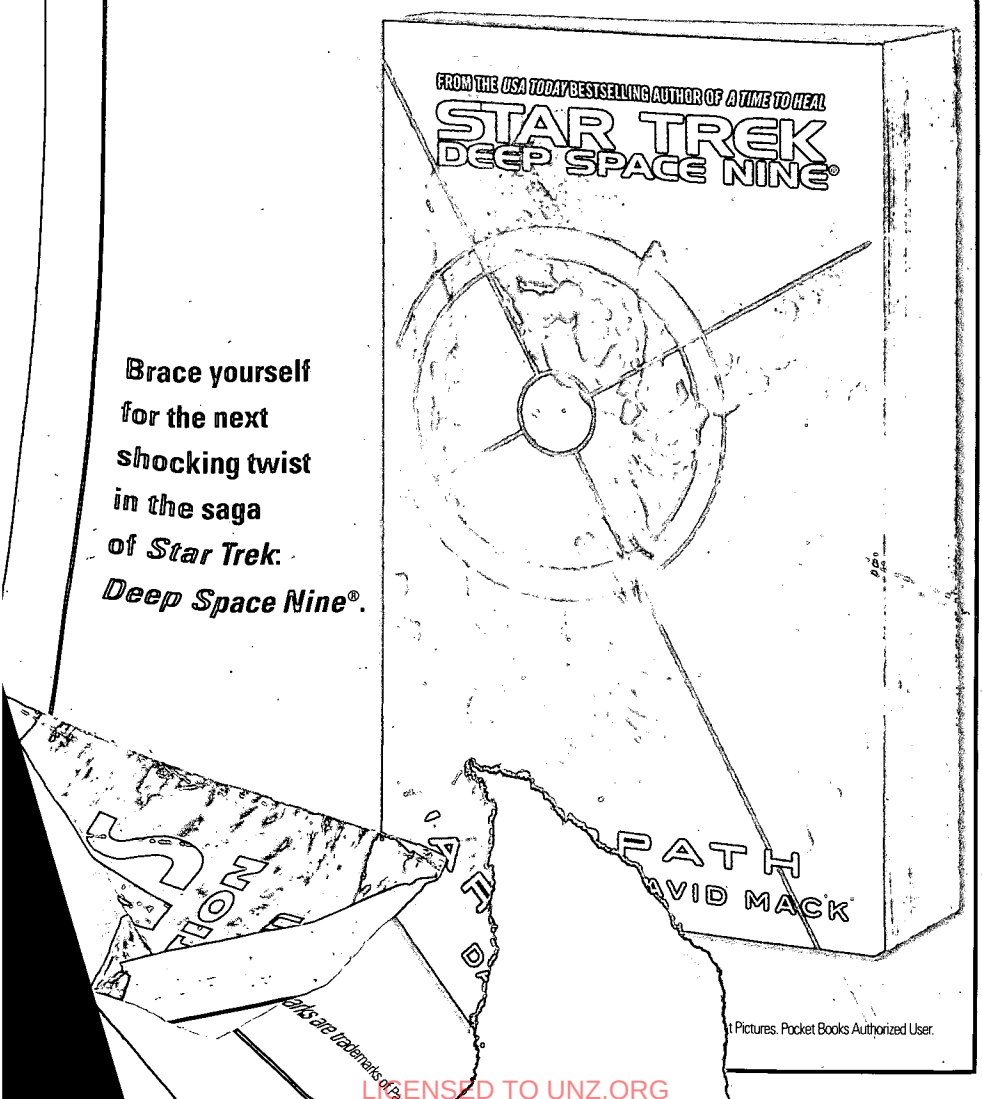
Tasked for peace.
Lost to madness.



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